Table A3.3-4 **CROP DIVERSIFICATION PLAN IN THE OLD AREA**

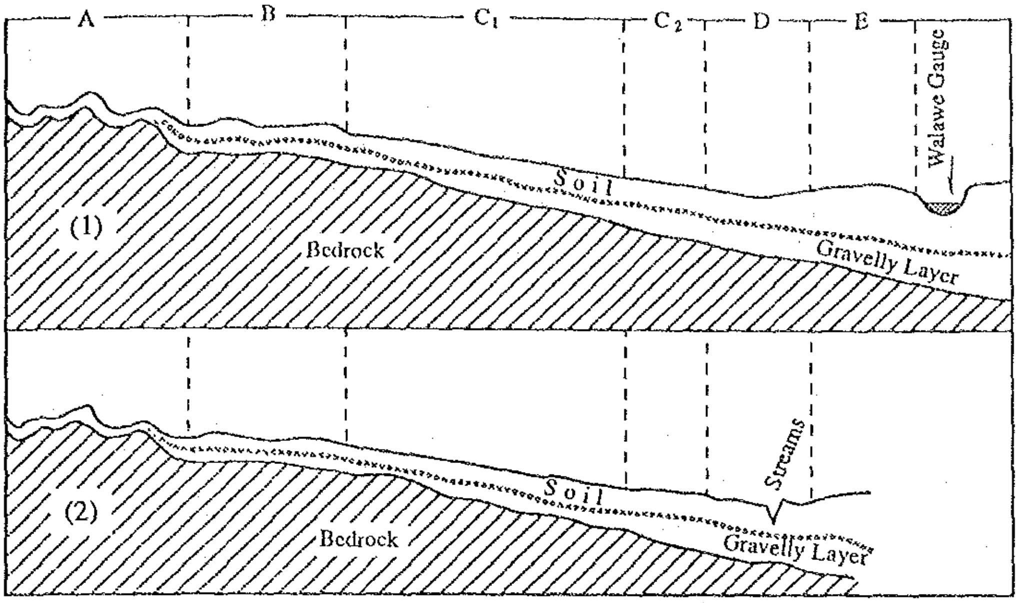
Item	Present Conditions					With Project Conditions				
	LHG (poor)	RBE (Mod.)	RBE (well)	Total	(%)	LHG (poor)	RBE (Mod.)	RBE (well)	Total	(%)
1. Old Area										
A. Existing Irrigation Area										
(1) Kiriibanwewa										
- Paddy	990	320	30	1,340	91%	990	50	0	1,040	70%
- OFC's	0	110	30	140	9%	0	360	80	440	30%
Total of Kiriiban	990	430	60	1,480		990	410	80	1,480	
(2) Suriyawewa										
- Paddy	570	470	220	1,260	89%	570	170	0	740	52%
- OFC's	0	30	130	160	11%	0	340	340	680	48%
Total of Suriyawewa	570	500	350	1,420		570	510	340	1,420	
(3) Total of Existing Area										
- Paddy	1,560	790	250	2,600	90%	1,560	220	0	1,780	61%
B. - OFC's	0	140	160	300	10%	0	700	420	1,120	39%
Total	1,560	930	410	2,900		1,560	920	420	2,900	

Table A3.3-5 PROPOSED LAND USE

Present Land Use	without Project	With project (Planed Land Use) Homesteads	Irragated Area* Paddy	Sugar	B. Onion	Banana	Vegetable	Total Irrigated Area	Upland (Rainfed)/ Chena	Other	Plantation	Livestock farm	Shrub/ Pasture Land	Open/ Firewood Forest	Forest reserve	Barrenland Rock
A Existing Irrigation Area																
1. Sevanagala Sugar Area																
(1) Homesteads	1,800	1,800														
(2) Sugarcane (Irrigated)*	1,120			1,120				1,120								
(3) Paddy (Irrigated)*	370		370					370								
(4) Upland (Rainfed)	985		360	525				885		100						
(5) Open Forest	620			375				375		60				185		
(6) Barrenland/Rocky Lands	60															60
(7) Others	485									485						
Sub-total	5,440	1,800	730	2,020	0	0	0	2,750	0	645	0	0	0	185	0	60
2. Old Area																
(1) Homesteads	2,490	2,490														
(2) Paddy (Irrigated)*	2,540		1,780		240	260	260	2,540								
(3) Upland crops (Irrigated)*	360			220		140		360								
(4) Paddy (Rainfed)	70		60					60		10						
(5) Upland (Rainfed)	2,180		380	600				980	1,030	170						
(6) Open Forest	260													260		
(7) Shrub	605												605			
(8) Livestock farm	25											25				
(9) Barrenland/Rocky Lands	700															700
(10) Others	1,810									1,810						
Sub-total	11,040	2,490	2,220	820	240	400	260	3,940	1,030	1,990	0	25	605	260	0	700
B Extension Area																
(1) Homesteads	200	50	70		50			120		30						
(2) Paddy (Rainfed)	260		220					220		40						
(3) Chena/upland crops	2,520		800		340		50	1,190	1,120	210						
(4) Open Forest	740	50												690		
(5) Plantation	20										20					
(6) Forest Reserve	960														960	
(7) Shrub	10,310	1,100	1,230	2,180		210	190	3,810		680		410	4,310			
(8) Barrenland/Rocky Lands	490															490
(9) Others	200									200						
Sub-total	15,700	1,200	2,320	2,180	390	210	240	5,340	1,120	1,160	20	410	4,310	690	960	490
Total	32,180	5,490	5,270	5,020	630	610	500	12,030	2,150	3,795	20	435	4,915	1,135	960	1,250
(MEA Managed area)	26,740	3,690	4,540	3,000	630	610	500	9,280	2,150	3,150	20	435	4,915	950	960	1,190

*: Net irrigation area only

FIGURES



Note: (1) Prepared by Land Use Division, 1981.
(2) Intermountain Valley Bottom Modified by Study Team, 1992.

	Landscape	Slope (%)	Soil Type
A	Hilly terrain, mostly foothill and footslopes of mountains.	16 - 30	Reddish Brown Earths
B	Rolling mantled plain.	8 - 16	Reddish Brown Earths
C_1	Upper slopes of undulating mantled plain.	2 - 8	Reddish Brown Earths
C_2	Lower slopes of undulating mantled plain	2 - 8	Moderately to imperfectly drained Reddish Brown Earths
D	Valley flat level to gently undulating valley bottoms and food plains.	0 - 2	Poorly drained Alluvial Soils and Low Humic Gley Soils
E	River levees of flood plains.	0 - 2	Moderately to imperfectly drained Alluvial Soils

Fig. A3.1-1 Schematic Diagram of Landscape, Slope and Soil in Agro-ecological Region DL-1

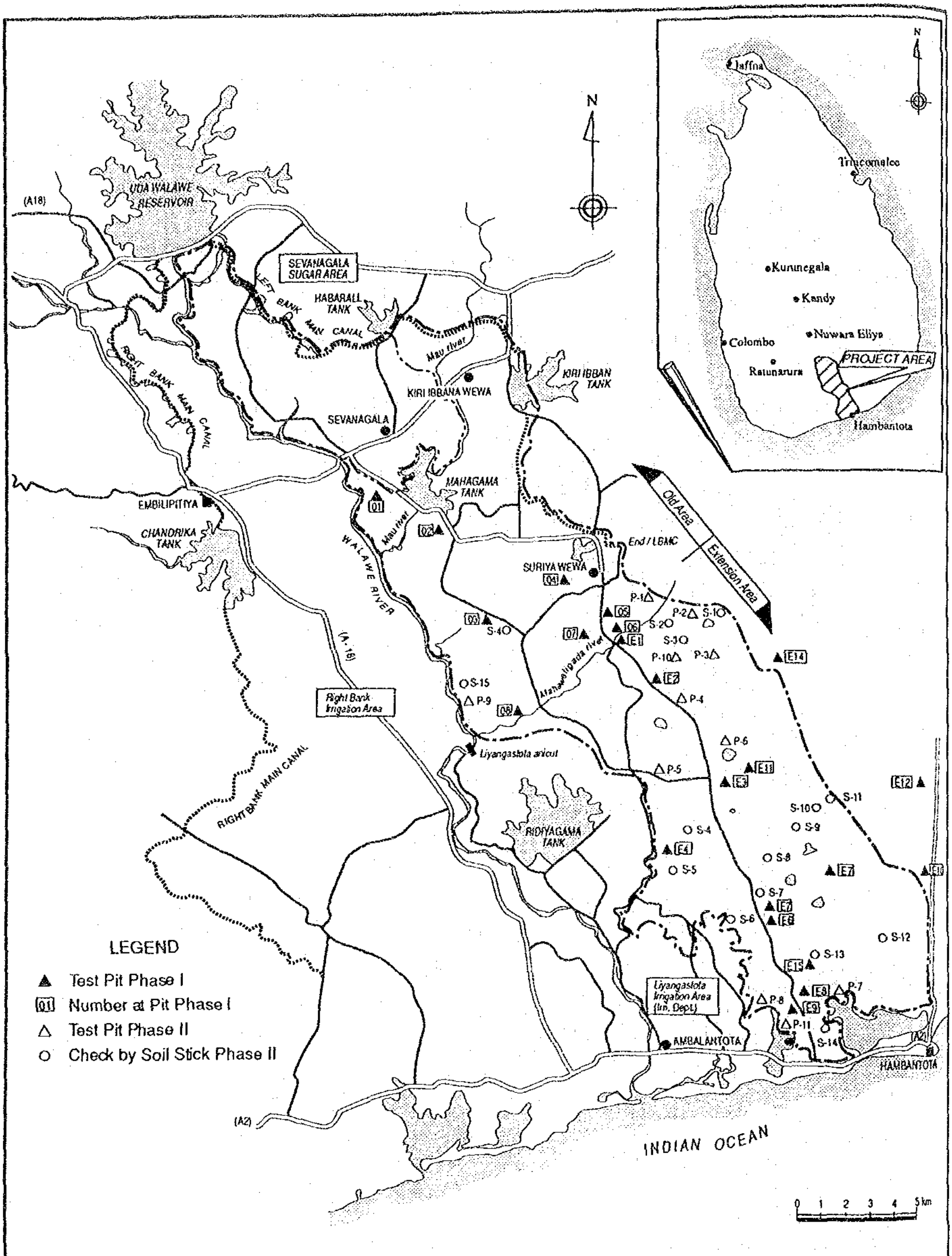


Fig. A3.1-2 Location of Test Pits for Soil Survey

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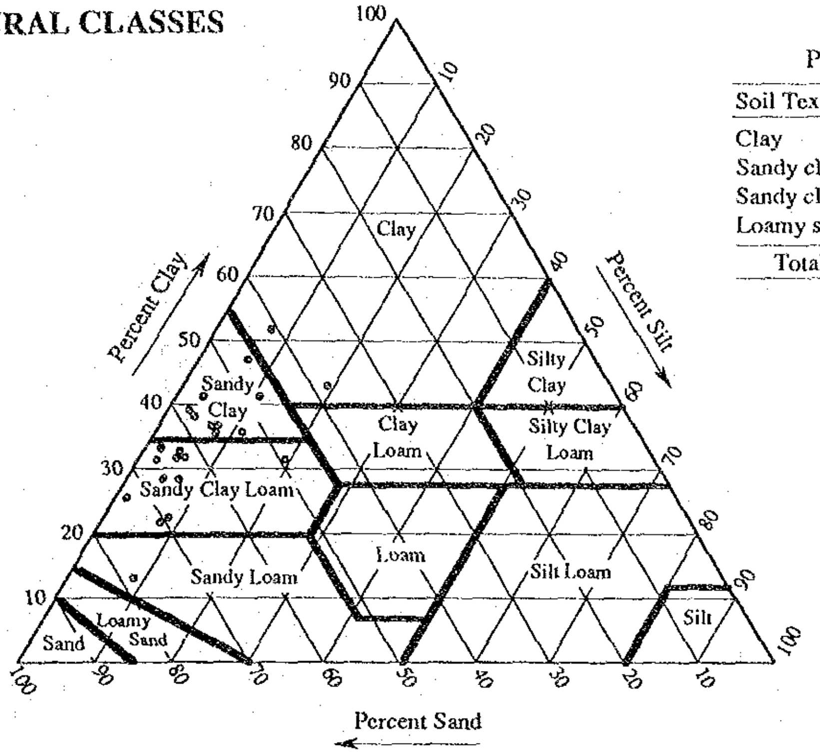
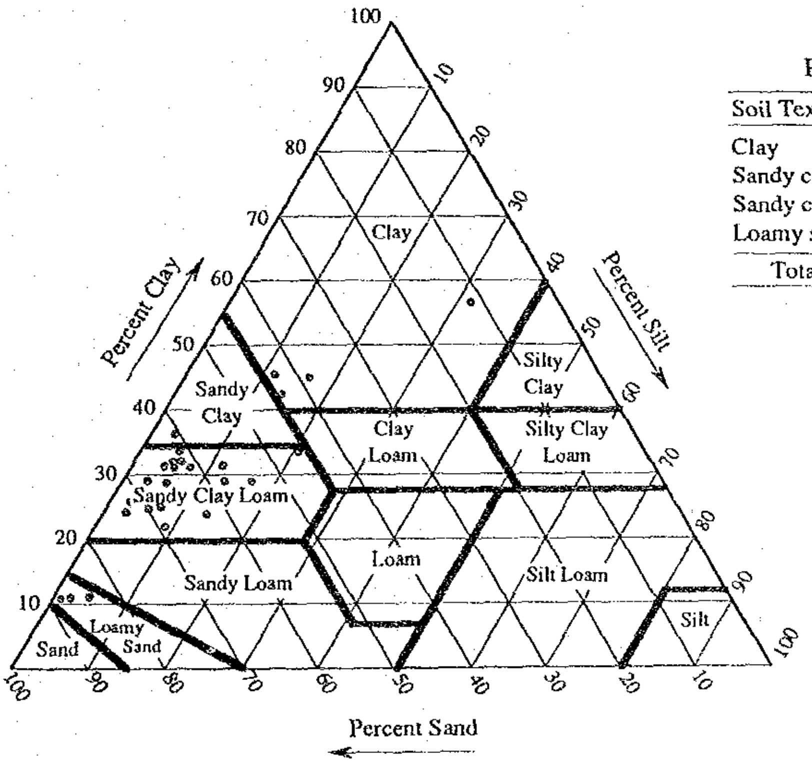
TEXTURAL CLASSES



Phase - I

Soil Texture	%
Clay	9
Sandy clay	39
Sandy clay loam	48
Loamy sand	4
Total	100



Phase - II

Soil Texture	%
Clay	13
Sandy clay	7
Sandy clay loam	69
Loamy sand	11
Total	100

Fig. A3.1-3 Textual Classes of Soil

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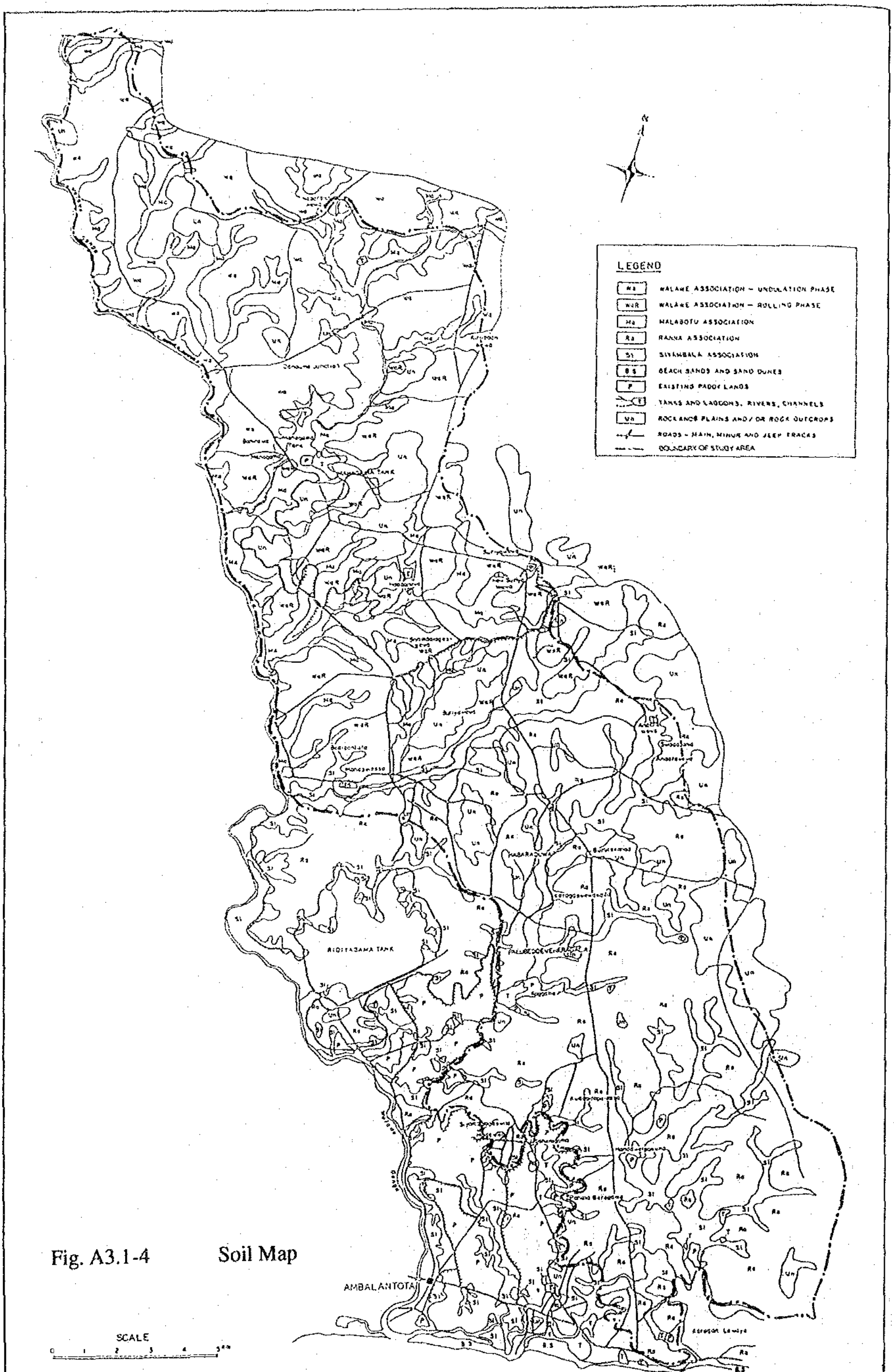


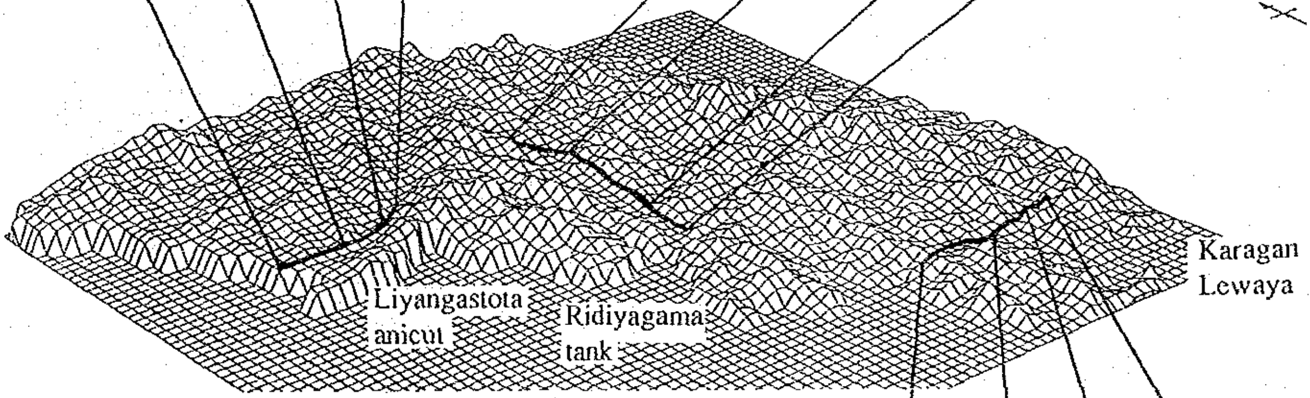
Fig. A3.1-4 Soil Map

GENTLE SLOPE

0-2%	3-4%	2-3%
LHG	RBE	RBE
Poorly drained	Well drained	Poorly drained
5d/1	1/3st	3d/1
paddy	Upland/ Crop	* Vegetable

MEDIUM SLOPE

3-4%	2-3%	0-2%
RBE	RBE	LHG
well drained	Imperfectry drained	Poorly drained
2pt/3st	3d/2t	5d/1
Upland Crop	Upland/ * Vegitable	Paddy



STEEPER SLOPE

2-3%	4-6%	>6%
RBE	RBE	RBE
Poorly drained	Well drained	Poorly drained
3d/2t	3t/6st	6t/6st
Upland/ * Vegitable	Homestead/ tree crops	Forestry

LEGEND

0-2%	Gradient %
LHG	Soils
Poorly	Drainage
5d/1	Land Class
Paddy	Potential Land use

Fig. A3.3-1 Relationship between Soil and Land Capability

Annex - IV

Topographic Surveys

ANNEX-IV TOPOGRAPHIC SURVEYS

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ANNEX-IV TOPOGRAPHIC SURVEYS

4.1 Available Topographic Data and Information

Following maps and topographic information are collected for the study :

(i) Engineering Survey Map (scale of 264 feet to one inch, 1/3,170)

The map titled as "Walawe Ganga L.B. Engineering Surveys, S.P. & Uva" was prepared in the period from 1956 to 1964 by the Survey General as a project base map for the development of the Walawe area. 180 sheets in total covering entire study area were provided by MASL for the Study. The map shows the contours at 2 feet (about 0.6 m) intervals, streams and rock outcrops, and other information such as roads and irrigation canals of Ridiyagama tank scheme. Land use condition and vegetation condition are, however, not indicated clearly. The map does not show the present major land marks such as Uda Walawe tank, LBMC, Kiriiban tank, Suriyawewa town and road which were constructed in 1960's and later by the previous projects.

The map showing the coverage of the ""Engineering map" for both right and left bank areas area shown in Fig. A4-1.

(ii) National base map (colored map, scale of 1/50,000, CI=30 m (100 ft))

The map was published in 1985 by Survey Department of Sri Lanka based on the aerial photographs taken in 1982 and 1983. The map shows general features of land conditions as well as project infrastructure such as Uda Walawe tank, left bank main canal (LBMC), branch canal, tanks on the LBMC constructed by the Government in 1960's.

(iii) Aerial photographs (contact print, black and white)

The aerial photographs were taken in 1982 and 1983 with a scale of 1/20,000; 246 sheets covering the study area were provided by MASL for the study.

(iv) Topographic survey map along the proposed extension routes of LBMC and the two new branch canals in Suriyawewa Block

The map was prepared by MEA-Walawe Project Office in 1988 with an scale of 1/2,000; total surveyed length is about 12 km long.

(v) Block out layouts of Suriyawewa and Kiriibanwewa block (S=1/9,230)

The map was prepared by MEA-Walawe office in 1991 for their operation and management. Map Shows boundary of plots with plot numbers, roads, irrigation area and canals, natural streams, household areas. Counter line is not indicated on the map.

4.2 Topographic Surveys Executed under the Study

Following topographic surveys were carried out by MASL based on the technical specifications prepared by the Team:

(i) Plan and profile with cross sections of the existing Left bank main canal and Beddewewa branch canal

The topographic survey work was carried out by the MASL based on the technical specifications prepared by the Team in 1991. The purpose of the survey was to prepare the drawings of plan and profile, and cross sections of the existing Left Bank Main Canal (LBMC) and Beddewewa Branch Canal (BBC) to grasp the present canal conditions and to examine the flow capacity of the canals. The main points mentioned in the technical specifications are;

- Cross sectional survey with 100 m interval in principal including farm roads along the canals. The traversing survey along the canals is to be carried out to identify the locations of the cross sections ;
- Preparation of drawings including; (i) plan and longitudinal profile with indication of structure location (scale of 1 to 5,000), and (ii) cross sections of the objective canals (scale of 1 to 200) ;
- Authorized bench mark of elevation, which is corresponding to the available topographic map, shall be used for the survey.

As a result of the survey, following data and information was prepared by MEA:

Item	Survey length (km)	Nos of sections	Nos. of sheets
Plan and profile			
LBMC	30.28		10
BBC	6.04		2
Cross sections			
LBMC		431	55
BBC		98	9
Total	36.32	529	76

(ii) River cross sectional survey

River cross sectional survey were carried out for the following point to study the Timbolketiya Diversion plan and bridge on the Walawe river which will connect left and right bank area.

- Walawe river at proposed bridge site
- Timbolketiya river for three (3) alternative intake weir sites

(iii) Bench mark survey for the extension area (19 nos. of bench marks are installed)

Canal route survey for the proposed extension LBMC route, which was scheduled in the Interim Report, was cancelled upon due consideration of work rate of 24-surveyor-months estimated by Survey Department of the Ministry, vegetation conditions on the route, and available period of 2 months for the field work.

Bench mark survey was implemented to compensate the cancellation of the route survey of LBMC and to install the bench marks mainly along Suriyawewa - Mirijjiwila road aiming to check the ground level information of available 'Engineering Survey Map". In the technical specification, an allowable error of levelling was set at 24 mm x sq-root S, where S is single distance of levelling in km). Location of bench marks and these elevations area presented in Fig.A4-2.

FIGURES

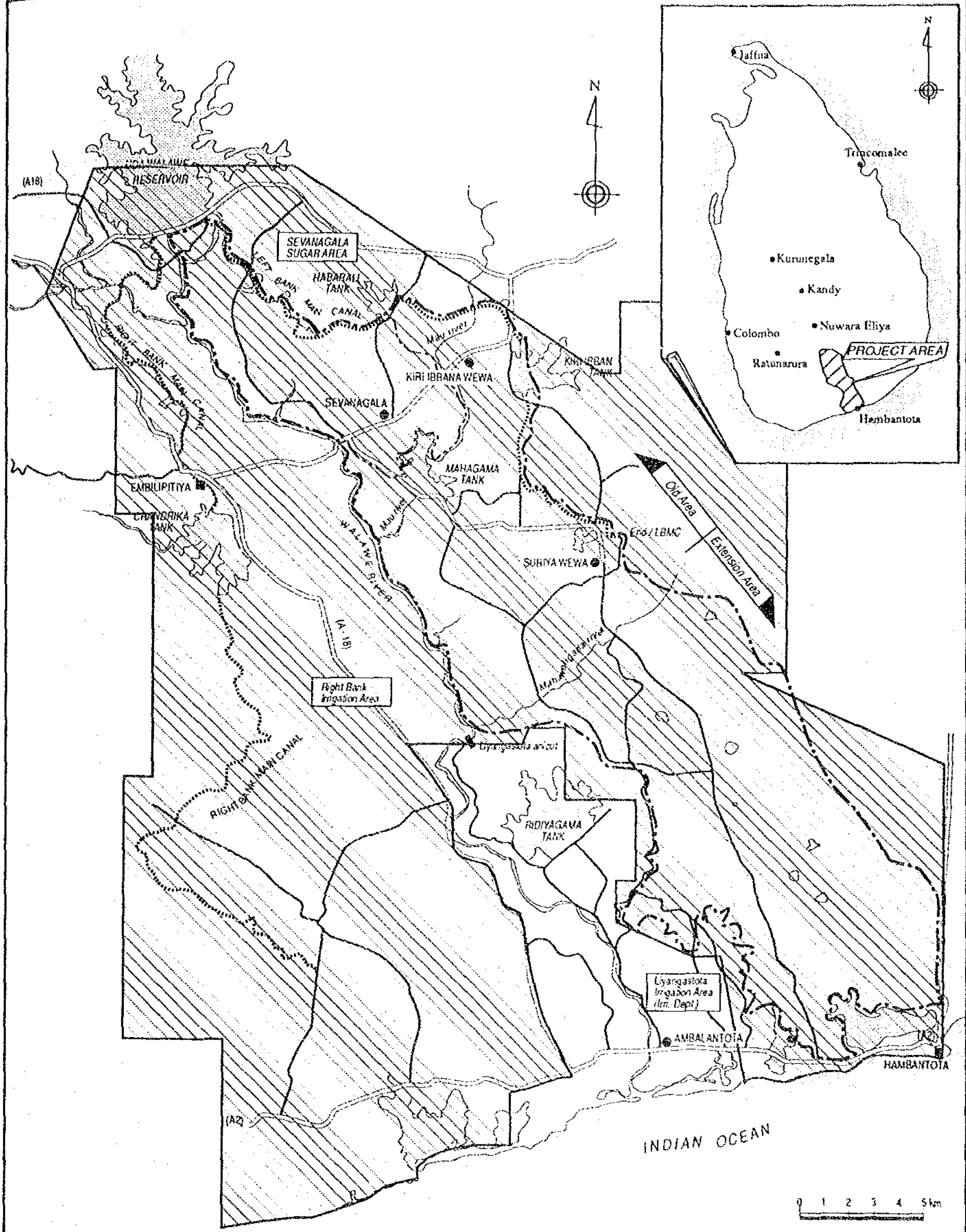

Fig. A4-1 **COVERAGE OF ENGINEERING SURVEY MAP PREPARED IN 1960s**

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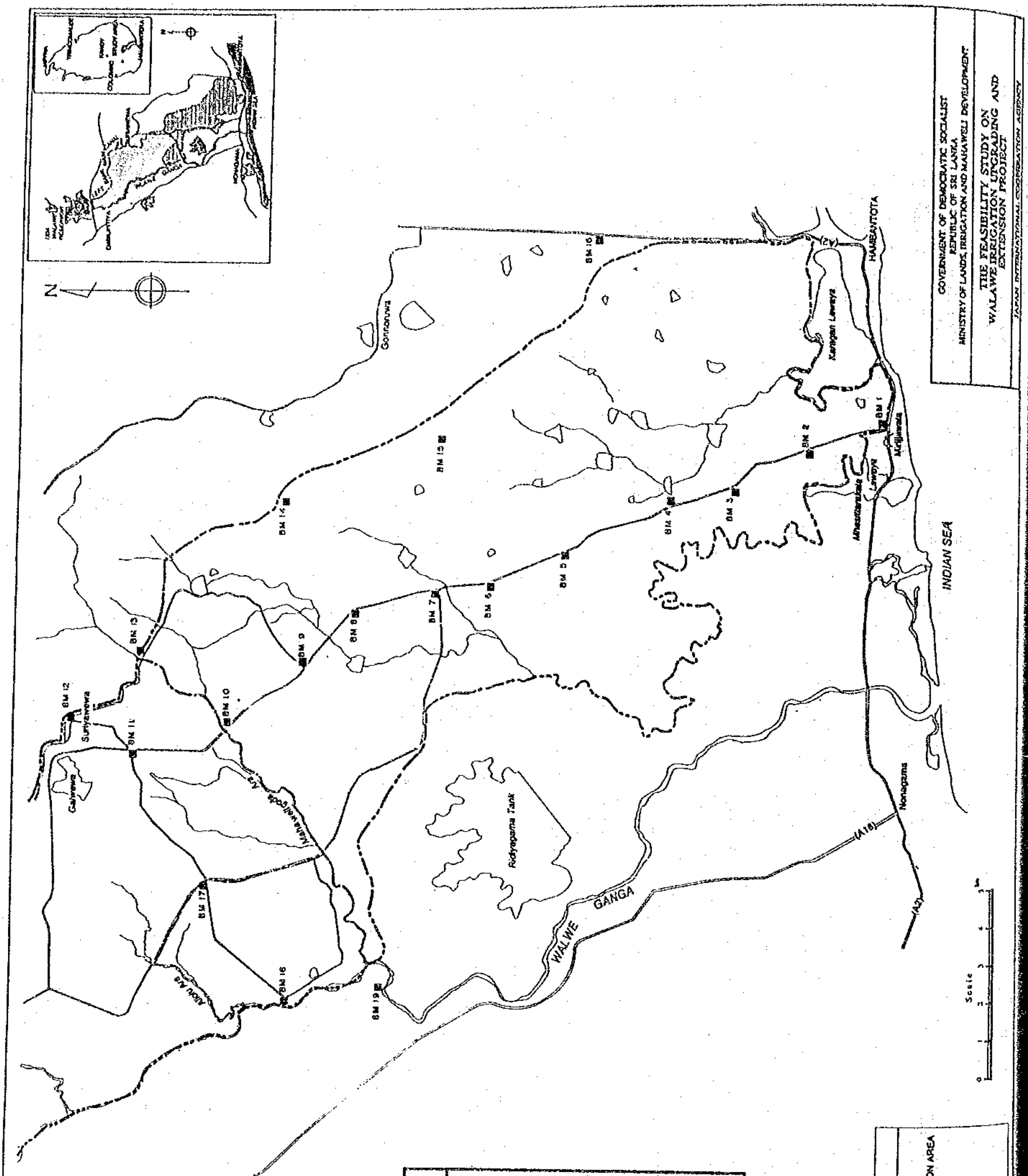

LIST OF BENCH MARKS

B M		Elevation (m)
BM	- 1	7.704
BM	- 2	20.722
BM	- 3	21.200
BM	- 4	23.982
BM	- 5	44.904
BM	- 6	27.042
BM	- 7	22.010
BM	- 8	43.285
BM	- 9	44.418
BM	- 10	47.056
BM	- 11	64.067
BM	- 12	65.605
BM	- 13	69.831
BM	- 14	43.051
BM	- 15	48.498
BM	- 16	35.559
BM	- 17	58.455
BM	- 18	28.904
BM	- 19	24.973

Note: The survey was made by MEA/MASL in July 1992

Fig. A4-2 LOCATION OF BENCH MARKS ESTABLISHED IN THE STUDY

Annex - V

Geology and Soil Mechanics

ANNEX-V GEOLOGY AND SOIL MECHANICS

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ANNEX-V GEOLOGY AND SOIL MECHANICS

5.1 General

5.1.1 Objectives of the Study

The objectives of the study on the geology and soil mechanics during the feasibility study are to review and evaluate geotechnical data and information having being made available during the study, to present recommendations on the geotechnical aspects of the Study area.

5.1.2 Geological and soil mechanics information

The data obtained and their sources are listed in References, and the explanations of the data and information obtained are given below.

(1) Geological data

The regional geological reports and maps were prepared in the Geology of Ceylon by P.G.COORAY in 1967. The regional geology and mineral resources were prepared in Economic Geology of Sri Lanka by J. W. HERATH in 1985.

The geological report and map at a scale of 1: 126,720 (1 inch to 2 miles)of the Walawe Ganga Basin were prepared by the Photographic Survey Corporation, Limited, Canada in co-operation with the Surveyor General of Ceylon in 1960. The geological survey map at a scale of 1: 63,360 (1 inch to 1 mile) was prepared by Geological Survey Department in 1964, which provides valuable geological information covering the Study area.

(2) Geotechnical data

The technical report of the Uda Walawe Project was prepared by Engineering Consultants, Inc., U.S.A., in 1962. The soil map at a scale of 1: 63,360 (1 inch to 1 mile) was prepared by River Valleys Development Board in 1968, which provides useful superficial soil conditions in and around the Study area.

(3) Wells data

There is an on-going project on the right bank area of the Walawe river, which is the Uda Walawe Right Bank Rehabilitation Project by Mahaweli Engineering & Construction Agency (MECA).Data of wells which were drilled by Water Resources Board were obtained from Mahaweli Economic Agency (MEA) Office in Embilipitiya.

(4) Water wells data

The water wells data in Integrated Rural Development Program funded by NORAD since 1986 were obtained from Integrated Rural Development Project Office in Hambantota.

5.2 Geology

Geological survey has been conducted in and around the Study area aiming at collecting geological and geotechnical information related to the proposed structure foundations and construction materials.

The survey comprises a detailed geological survey in the Study area, a reconnaissance survey around the Study area, observations of geological conditions of existing canals, water wells and quarries.

The explanations of the data and information obtained are given below.

5.2.1 Regional geology

The Island of Sri Lanka is divided into the Coastal Regions and the Central Highlands. The Coastal Regions are nearly flat and the rivers flowing through these plains have reached their base-level of erosion.This region is narrow on the western and southern sides of the island, widens along the east side and occupies the entire northern half of the island. The Central Highlands comprise the southern central part of the island with mountain peaks to heights in excess of 2,300 m.

Most of the island consists of crystalline and foliated metamorphic rocks of Precambrian age with only a narrow fringe of more recent sediments (Jurrasic, Miocene and Quaternary) along the coast.

The Precambrian complex is divided into two Series, the Highland Series (the Charnockite Series) and the Vijayan Series. The Highland Series consist predominantly of a sedimentary succession of a great variety of rocks now converted into a succession of banded gneisses, granulites, quartzites and marble.

The Vijayan Series consist of a group of biotite and hornblende-biotite gneisses, and are widespread in the lowland which form the eastern and south-eastern sector of the island.

These two Series make up the foundation rock in the Study area.

A few square kilometers of Jurassic deposits are found near Puttallam. They are shallow water deposits and consist of sandstones. The only extensive development of sedimentary rocks is along the northwest coast of the island which is composed of limestones of Miocene age.

Several dolerite dikes, small granitic bodies, and a series of pegmatite and quartz veins have been intruded into the Precambrian rocks.

5.2.2 Geology in and around the Study area

The Study area is situated in a part of the coastal peneplain of Sri Lanka, cut into the southern Precambrian complex. The geological units occurred in and around the Study area comprise the Highland Series (the Charnockite Series) and the Vijayan Series of Precambrian age, and the Quaternary sediments.

The geological map are illustrated on DWG-7.

(1) The Highland Series (the Charnockite Series)

Rocks of the Highland Series occupy the western and northwestern part of the Study area. The eastern boundary of the Highland Series is nearly along the Walawe river and the foot hills of the central highlands where a transitional zone lies between it and the Vijayan Series on the east and southeast.It is noted that basement rock in whole right bank area of the Walawe river is belong to the Highland Series.

The Highland Series in the Study area comprises an extensive group of well-bedded rocks including hornblende-biotite gneisses, charnockitic biotite gneisses, quartzo-feldspathic gneisses, garnetiferous granulites associated with layers of quartzites, quartz schists, marbles and charnockites. One of the most striking features of the Highland Series is the close and intimate association of metasediments and charnockite.

The charnockites occur as massive, dense, homogeneous,greenish gray bodies and rarely show foliation. They are composed largely of quartz, feldspar, hypersthene and biotite with minor amount of hornblende and garnet. The charnockites occur probably in elongated lenses, which follow the strike trend of foliation.

The marbles occur as bands, from about 200 m to 1,000 m wide, intercalated with quartz schist, qurtzites and charnockites, which can be traced for several kilometers along the strike.Main mineral of the marbles is calcite with biotite, graphite and apatite as accessories.

(2) Vijayan Series

The rocks of the Vijayan Series are widespread in the Study area. The area where the Vijayan Series have been identified are characterized by low relief, although steep-sided erosional remnants of fresh rocks occur in many places, particularly at the ridges along the proposed main and branch canals in the Extension area.

The rocks of the Vijayan Series are mostly microcline-bearing quartzo-feldspathic rocks with layers and lenses of biotite and/or hornblende. The main rock types include a variety of gneisses and granitic rocks. They are mostly biotite gneisses, hornblende gneisses and hornblende-biotite gneisses, with associated granitic gneisses, granites and charnockitic gneisses.

They are generally fresh, massive, solid and hard at outcrops. The fresh rocks can not be scraped by hydraulic ripper.

Many pegmatite veins and several quartz veins occur along joint systems and gneissic foliations. Pegmatites veins are widely distributed and have a thickness of up to 2.5 m. They have been intruded indiscriminately into most of the rock types previously described. They have an eastnorth-east trend and a steep northwest dip. They are mostly quartz-feldspar pegmatites with associated biotite.

Quartz veins are found in a scattered pattern in the Study area. They are massive vein quartz with minor amount of biotite, measuring 1 cm to more than 10 m thick. They are the hardest rock in the Study area and remain as unweathered body. They have a north-northwest trend and a nearly vertical dip.

Graphic granite composed of quartz and microcline feldspar with elongated interlocking crystals are found locally.

(3) Quaternary sediments

Resting on the Precambrian rocks in the Study area are a variety of consolidated and unconsolidated material consisting largely of gravels, sands, silts and clays. These deposits belong to the Quaternary System. The Quaternary System consists of Pleistocene and Holocene.

1) Pleistocene

The Pleistocene consists of two formations; an upper red earths formation and a lower gravel deposit. The two formations are fairly well defined though locally they appear to merge into each other both vertically and laterally.

The gravels show various shades of red and brown in brown silty and sandy matrix. They consist mainly of sub-angular fragments of quartz of up to pebble size (D=0.2-5 cm) with minor amount of fragments of unweathered rock and garnet. They occur as thin beds or lenses less than 1.0 m thick in pits and canal wall. They are not always present and their distribution is patchy. Where they are absent, the red earths directly overlie the Precambrian rocks. On the other hand, where the exposures of the Precambrian rocks are closely spaced, the soils are very thin and consist mostly of gravelly silt with some cobbles and small boulders.

The red earths consist mainly of reddish brown silty sand or sandy silt. They are composed mainly of very fine to fine-grained quartz. They have developed in a parent material derived, by weathering,from the underlying Precambrian rocks. This bedrock is normally gneisses which are intruded in some places by pegmatites.

2) Holocene

The Holocene (recent deposits) consists of alluvial and lagoonal sediments, and beach and dune sand.

Alluvial sediments have been deposited in and around the rivers, the small streams and tanks. The Walawe river is having alluvial sediments of about 1 m and more thick. They are composed mainly of gray sand (fine to coarse-grained) with or without silt. Other alluvial sediments found in the Study area rarely exceed 4 m, according to the observation of existing water wells. They are silty or clayey and occasionally contain peaty clay in the small streams and tanks.

The dune sand along the coast consists of fine to medium-grained, wind blown sands.

(4) Structure of the Precambrian rocks

General structure of the Vijayan Series in the Study area is rather simple. The rocks strike NS to N45W and dip southwestwards relatively consistently and gently. There are several anticlines and synclines, in minor scale. Direction of fold axis follow the general strike of the rocks.

No faults have been identified in the Study area, because of sparse exposures of rocks on the surface.The fact does not necessarily mean that none exist.

The Precambrian rocks of the Study area are very poorly jointed at outcrops. The joints which strike east-north-east and dip nearly vertically have been identified in some places. They usually have joint planes more than 50 cm apart.

5.2.3 Geohydrology

(1) General

According to "The Hydrogeochemical Atlas of Sri Lanka" published by the University of Peradeniya, Department of Geology,ground water over the Uda Walawe basin can broadly be classified into Calcium type for the upper stream, Magnesium type for the middle stream and Sodium/Potassium type for the downstream based on the Triliner Diagram. Non-dominant Cation type is further distributed in places over the basin.

The inhabitants of the Extension area obtain their drinking water requirements from various sources such as open wells, deep wells, water pipe lines and other sources.

(2) Shallow wells

Alluvial sediments which can be named as shallow water aquifers is not widely spread over the Study area. It is limited to the area in and around the rivers and the small streams. Thick insitu sediments of the Pleistocene age and the weathered bedrocks also have a potential for shallow ground water that can be extracted through dug wells.

Most of the inhabitants of the Extension area use shallow open wells (average depth; 4 to 5 m), to obtain their drinking water requirements. Furthermore, most of the shallow wells in use consist of unprotected wells and do not possess potable water due to the presence of excess chlorides, fluorides and etc. Many wells are also directly recharged from surface water sources, such as irrigation tanks, canals and etc. The shallow wells are liable to get polluted from surface drainage.

A major percentage of the wells went dry in these 2 years and thus cause severe hardships to consumers. In most of these cases, the wells could not be deepened by hand due to the presence of hard rock at the bottom.

(3) Deep borehole wells

Fractured zones in the Precambrian rocks can be introduced as deep aquifers. As fractures are penetrated through, the yield of the well is increased.

More than 80 deep boreholes have been constructed in and around the Extension area and hydrogeochemical analysis have been carried out for the water in Integrated Rural Development Program funded by NORAD. Distribution of yield, electrical conductivity and fluorides are illustrated on Fig. A5.2-1, Fig. A5.2-2 and Fig. A5.2-3 respectively. A majority of these deep wells yield small quantity of water (less than 25 liters/minute) and display higher electrical conductivity (more than 2,500 micro mhos/cm) and higher concentration of fluorides (more than 1,500 ppb) than WHO standards for drinking water. Though deep borehole penetrates through the fractured zones and yields a large quantity of water, quality of the ground water in the Extension area is poor.

5.3 Geotechnical Evaluation of Structure Foundation

5.3.1 General

Major structures proposed in the Study area are the Walawe bridge, water intake weirs, main canal and small scale tanks. The Walawe bridge is located at the central western end of the Study area near Bedigantota, and the water intake weirs are located at the northwestern part of the Study area near Timbolketiya, and main canal and small scale tanks extend to the whole Extension area.

Eleven deep test pits (more than 1 m deep) were made to check the foundation of structures.

The locations and soil profiles of the test pits are illustrated on Fig. A5.3-1 and Fig. A5.3-2 respectively.

5.3.2 Walawe bridge site

Three test pits (T-3, T-5 and T-6) have been made at the proposed bridge site, aiming to clarify the subsoil conditions at the bridge site.

The overburden is composed mainly of brown to brownish gray silty sand or sand (very fine to medium-grained).

The weathered biotite gneiss was found at approximately 4 m in T-5, and the presence of the bedrock has been presumed at 4 m in T-6 as a result of sounding by an iron bar.

No bedrock was found up to 5 m deep in T-3.

An exposure, measuring 3 m by 5 m, of hornblende-biotite gneiss which is intruded by a pegmatite has been identified in the bed of the Walawe river near T-5.

The ground water table were found to exist at 4.5 m in T-5 and 2.9 m in T-6 respectively. These shallow water tables are thought to be caused by the close locations to the river.

From the above findings, a line connecting T-5 and T-6 was selected as the axis for the bridge.

There shall be certain possibility to place the whole bridge base directly on the weathered bedrocks, if an open-cut excavation for the abutments and piers would extend more than 5 m from the original ground surface.

Those weathered bedrocks below the overburden are compact and tight, but not hard. It then is found necessary to conduct drilling until sound, dense, fresh rock below the zone of weathered material has been encountered.

5.3.3 Water intake weir sites on the Timbolketiya river

Three test pits (T-1, T-2 and T-4) have been made at the proposed weir sites. Two of them have been made at the both banks of the Andlu Ganga, and remaining one (T-4) has been made at the left bank of the upper stream of the Timbolketiya Ganga.

(1) Andlu Ganga

The overburden is composed mainly of reddish brown silty sand and yellowish brown silty sand.

The weathered quartz schist was found at 1 m in T-1, and nearly fresh marble which had the uneven surface was found at 1.2 m and 3 m in T-2.

The ground water table were found to exist at 1.7 m in T-1 and 1.4 m in T-2 respectively. The shallow ground water tables in both pits are thought to be caused by the close locations to the river.

There shall be certain possibility to place the whole weir base directly on the weathered bedrocks, if an open-cut excavation for the weir body extend more than 4 m from the original ground surface.

Those weathered rocks below the overburden are tight and fairly sound, but not so hard. It then is found recommendable to conduct drilling until fresh rock below the zone of weathered material has been encountered.

(2) Upper stream of Timbolketiya Ganga

The overburden is composed of yellowish brown fine sand and sandy silt .

The strongly weathered biotite gneiss was found at 3 m in T-4, but no ground water table was found up to 3 m deep.

An exposure, measuring 10 m by 15 m, of nearly fresh biotite gneiss has been identified in the bed and right bank of the river near T-4.

There shall be certain possibility to place the whole weir base directly on the fresh or weathered bedrocks, if an open-cut excavation for the weir body extend more than 4 m from the original ground surface.

The weathered rock found in T-4 are compact and tight, but not hard.It then is found necessary to conduct drilling until fresh rock below the zone of weathered material has been encountered, at the left bank of the river.

5.3.4 Canals and tanks

The canal extends to the whole Extension area and will be constructed on the rocks of the Vijayan Series and the deposits of the Pleistocene and Recent age, so that the construction cost will be remarkably influenced by the subsoil conditions.

Taking into account the above view,five test pits (T-8,T-9,T-12,T-13 and T-14) have been made on the proposed canal route in the Extension area, aiming to clarify the subsoil conditions of canal route.

And detailed geotechnical survey has been conducted in the Extension area. The survey include an observations of subsoil conditions of existing canals, and water wells.

The upper part of the overburden is composed mostly of brown to reddish brown silty sand (very fine to coarse-grained)with gravelly zones. The lower part of the overburden is composed generally of reddish brown gravelly silt which contains sub-angular fragments of quartz and unweathered rock of up to pebble size.

The weathered biotite gneisses were found at approximately 2 m in T-8, 3 m in T-9, 1 m in T-12, and 1.5 m in T-13 and T-14.

(1) Thickness of overburden

The overburden on which proposed canal and tanks shall be constructed consists mainly of the red earths and gravels.

Thickness of the overburden is illustrated on DWG-8. It varies in thickness from 0 m to as much as 6 m in the Extension area,from the observation of test pits,existing canals and water wells. They are commonly thinner (less than 2 m) at the ridge and thicker (more than 3 m) in the valley.

According to the wells data,the thickness of overburden in the right bank area of the Walawe river varies from 0.5 m to 3.6 m (average of 29 wells: 1.93 m).

(2) Weathering of bedrock

Below the overburden the bedrock has weathered down into dense granular tight layers and granular sandy material with some silt.The amount of weathering decreases with depth, with the change from weathered rock to fresh rock often abrupt. It seems that the fractured zones,sheared zones and zones with high concentrations of biotite show a thick weathering profile while the other parts remain with a thin weathered bedrock.

From the observation of test pits,existing canals and water wells, it also seems that weathered bedrock is thinner (0 to 1.5 m) at the ridge and thicker (more than 3 m) in the valley. In many places along the ridge, fresh rocks of the Precambrian age are exposed.

According to the wells data, the weathered bedrock in the right bank area of the Walawe river shows much thicker profile (2.25 to 25.45 m; average of 29 wells:9.9 m). High concentrations of biotite and well layered schistosity in gneisses and quart schist of the Highland Series might have formed thick weathered zones.

The weathered rocks can be scraped by hydraulic ripper.

(3) Canal open-cut excavation

The canal of which maximum depth will be approximately 5 m could be so designed to have a cut slope of not steeper than 1: 1.5 where ordinary sandy soils are developed. Along the existing main canal,in some places where the steeper cut slopes than 1: 1.5 were adopted, those slopes showed slope failures caused by the erosion.

Therefore, it could be necessary to take proper measure to protect the cut slope from the potential failures in the steeper cut slopes.

The permeability test results of sandy soils show that the coefficients of permeability being less than 1×10^{-5} (cm/s) are low enough for the canal. But it seems that the coefficients of permeability of the weathered gneiss are much higher than those of sandy soils. Therefore the cut slope and bottom of canal shall be protected from the potential seepages by such means as concrete lining.

(4) Foundation of embankments

After clearing or stripping of bushes and grasses from the ground surface on which the embankments shall be founded, the sandy soils will appear more often than the clayey soils throughout the Extension area as stated above.

The superficial sandy soils are classified mostly into SC in the Unified Soil Classification System as shown on Table A5.4-3. Such, sandy soil shall occur considerably along the alignment of the embankments.These soils have sufficient bearing capacity for the embankments, but are susceptible to erosion against seepage. Therefore those soils shall be treated properly by such means as a thorough blending with clayey materials so as to attain required imperviousness, or the bottom width of the foundation shall satisfy the required creep length to withstand a piping phenomenon.

5.4 Geotechnical Evaluation of Construction Materials

5.4.1 Laboratory test

(1) Quantity of work

The locations of the samples are illustrated on Fig. A5.3-1.

Quantities of tests are as shown in Table A5.4-1 and Table A5.4-2.

(2) Procedure

The tests were carried out by the Engineering Materials Laboratory of the Irrigation Department and in the National Building Research Organization. The laboratory tests have been carried out in accordance with the following test standards:

Test Item	Standards
a. Soil test	
1) Moisture content test	: ASTM D2216-80
2) Specific gravity test	: ASTM D854-83
3) Particle size analysis	: ASTM D422-63
4) Liquid limit test	: ASTM D423-66
5) Plastic limit test	: ASTM D424-59
6) Shrinkage factors test	: ASTM D427-83
7) Compaction test	: ASTM D698-78
8) Constant head permeability test on disturbed sample	: ASTM D2434-68
9) CBR test	: ASTM D1883-73
10) Swelling test	: ASTM D4546-85
b. Concrete aggregate test	
1) Specific gravity	: ASTM C127-84&128-84
2) Absorption test	: ASTM C127-84&128-84
3) Gradation	: ASTM C136-84
4) Aggregate crushing value	: BS812
5) 10% fine rock test	: BS812

(3) Test results

The laboratory test results are as shown in Table A5.4-3 and Table A5.4-4.

5.4.2 Earth materials for canal embankment

The earth work for the canal embankment is the most important factor to govern a success of construction work due to its biggest work quantity among all the work divisions. From geotechnical points of view, the embankment materials shall satisfy such major geotechnical characteristics as low permeability to assure water-tightness required as hydraulic structures, higher shear strength to assure a long-term slope stability, high resistance against erosion and piping,and good workability during construction.

On the other hand from an economical point of view, the earth materials used for the canal embankment which extend to the whole Extension area should be obtained nearby the embankment work site so as to shorten the hauling distance as much as possible.

Taking into account the above both views,t he Pleistocene, covering the whole Study area, and Recent deposits in the small streams and tanks are conceived as the potential materials for the embankment.

Eleven shallow test pits (less than 0.5 m deep) have been made to take samples for the tests for embankment materials.Combined with the samples from the above mentioned 11 deep test pits, 26 samples have been taken in total.

The locations and a list of soil samples are shown on Fig. A5.3-1 and Table A5.4-1 respectively. And the test results are as shown in Table A5.4-3.

(1) Classification and particle size

Sandy soils which shall occur considerably along the canal are classified mostly into SC in the Unified Soil Classification System. And 7 samples are classified into CL, CL/SC, CL/ML and MS.

Particle size test results show that minus No.200 sieve fraction (-74 micron)ranges from 9% to 72% and is 44% in average,and that clay fraction (-2 micron)ranges from 4% to 32% and is 16% in average for 22 samples. These results suggest that those sandy soils generally may have rather low permeability, moderate shear strength, rather low resistivity against piping phenomenon,and relatively poor workability particularly in a wet condition.

(2) Atterberg limits

The atterberg limits test results show that the liquid limit (LL) ranges from 21% to 43% and is 34% in average, and the plasticity index (PI) ranges from 3% to 24% and is 14% in average for 20 samples.

Embankment fill materials for canal shall consist of soils classified as CL, SC and their equivalents having the properties tabulated below.

Characteristic	Absolute Minimum	Absolute Minimum
Pass No.200 (-74 micron)	20%	70%
Liquid limit (LL)	20%	50%
Plasticity index (PI)	8%	30%

According to these restrictions, the samples in the Extension area are suitable for embankment fill materials except 4 samples from the Walawe bridge site,T-8 and T-15. It is judged that most of those samples are also suitable for core materials because they contain more than 30% of Pass No.200 except T-9(2).

(3) Shrinkage factor

The shrinkage factor (the linear shrinkage) ranging from 12.6% to 23.0% and being 16.9% in average for 18 samples indicates that the soils will have a high potential of volume change. This may result in cracking in the embankments when they are dried.

(4) Permeability

The coefficients of permeability range from 7.249 x 10^{-9} (cm/s) to 1.232 x 10^{-6} (cm/s), and is 2.175 x 10^{-7} (cm/s) in average for 7 samples.

The permeability being less than 1 x 10^{-5} (cm/s) is low enough for this type of embankment. This result, however,seems to be uncertain because of few samples. This must be clarified in a future.

(5) Swelling

The swellings obtained through CBR tests are less than 0.551 mm for 5 samples. In one dimensional swell or settlement potential tests, no swell was recorded.Subsequent application of vertical pressures shows only settlement in all the tests. These facts mean that soils having high swelling potential may not exist in the Extension area.

(6) Compaction

The compaction test results show that the optimum moisture contents (OMC) ranges from 9.2% to 21.5% and is 14.6% in average, and the maximum dry density (MDD) ranges from 1.546 (g/cm^3) to 1.903 (g/cm^3) and is 1.794 (g/cm^3) in average for 22 samples.

The compaction test results indicate that difference between the natural moisture contents (Wn) and OMC are rather small, that is, Wn is about 5% drier than OMC for 3 samples and is about 3% wetter than for 2 samples. This result, however, seems to be uncertain because of few samples. This must be clarified in a future.

5.4.3 Concrete aggregates

As potential concrete aggregate sources in and around the Study area,the followings are conceived and 4 samples (2 sand samples and 2 rock samples) have been taken from there.

The locations and a list of concrete aggregates samples are shown on Fig. A5.3-1 and Table A5.4-2 respectively.

The tests were carried out by the Engineering Materials Laboratory of the Irrigation Department. The laboratory test results are shown in Table A5.4-4.

(1) Sand materials

There are considerable sand deposits along the Walawe river that could be used for concrete. The two sand samples for testing have been taken from 2 locations along the Walawe river.

They are sand materials (fine to coarse-grained) at the proposed Walawe bridge site, and in Bolana about 1.5 kilometers north from Tawaluwila.

The sands of Bridge site are medium to coarse-grained, and contain no silt fraction.

The sands of Bolana are fine to medium-grained,and contain silt fraction of 0.9%.

They are conceived to be good sand materials for concrete aggregate.

(2) Rock materials

Twenty six quarries have been identified in and around the Study area. The locations of quarry are shown on Fig. A5.4-1. The rocks being quarried are classified as below.

Rocks	Number of quarry
Gneiss	18
Granite	2
Charnockite	3
Marble	1
Quartz vein	2
Total	26

Two rock samples for testing have been taken from 2 locations in the Study area.

They are biotite gneiss and hornblende-biotite gneiss of the Vijayan Series in Suriyawewa and Uda Beragama.

The aggregate crushing values range from 34.5% to 35%. The results indicate that the materials are not so hard for concrete aggregate to be used for high strength concrete such as concrete wearing surface of the road (aggregate crushing value; less than 30%). The materials, however, are hard enough for concrete aggregate to be used for other concrete (aggregate crushing value; less than 45%).

Since gneiss is the only potential rock material obtainable in the Extension area,gneiss should be utilized as much as possible from the economical point of view.

A charnockite sample of the Highland Series was conceived to be a good rock material for concrete aggregate and riprap rock as it showed a loss of 34% in the Los Angeles abrasion test,according to the test conducted by Engineering Consultants,Inc. Charnockite can be designated as alternative rock material but costly because of long haulage (about 30 km to the Extension area).

5.4.4 Road construction materials

Four soil and 2 gravel samples for CBR test have been taken from 6 locations in the Extension area.

The tests were carried out by the National Building Research Organization.

The laboratory test results are shown on Table A5.4-3.

The CBR values at 95% of the maximum dry density for 6 samples are less than 8% in all the tests and more than 3% except T-11.

The swelling rates obtained through CBR tests are less than 0.551% for 5 samples, which are regarded favorable as a subgrade of road.

The road embankment will be made mainly of the Pleistocene deposits nearby the road construction work site in a similar manner as the canal.

The road metalling materials, however, shall be borrowed from the sources other than the Pleistocene deposits, because to maintain the road motorable is indispensable even in the rainy season,and the Pleistocene deposits will not be able to meet the requirement due to their low strength.

Charnockite of the Highland Series and gneiss of the Vijayan Series are conceived as the potential materials for the road metalling materials.

5.5 Summary and Conclusion

5.5.1 Summary and conclusion

(1) Geological and soil mechanics information

The geological and soil mechanics information were reviewed to evaluate the geotechnical aspects in the Study area. The geological survey map was prepared by Geological Survey Department in 1964, which provides valuable geological information covering the Study area. The geotechnical information reviewed were mainly obtained from the report prepared for the Uda Walawe Project by Engineering Consultants, Inc., U.S.A., in 1962. The soil map was prepared by River Valleys Development Board in 1968,which provides useful superficial soil conditions in and around the Study area. Data of wells which were drilled by Water Resources Board were obtained from Mahaweli Economic Agency Office in Embilipitiya. The water wells data in Integrated Rural Development Program were obtained from IRDP Office in Hambantota.

(2) Geology in around the Study area

The geological units occurred in and around the Study area comprise the Highland Series (the Charnockite Series) and the Vijayan Series of Precambrian age,and the Quaternary sediments. The Study area is covered mostly with the gneisses of the Vijayan Series and with the Quaternary sediments consisting mainly of sandy soils. The rocks of the Vijayan Series strike NS to N45W and dip southwestwards relatively consistently and gently.There are several anticlines and synclines, in minor scale. No faults have been identified in the Study area. The fact, however, does not necessarily mean that none exist. The Precambrian rocks of the Study area are very poorly jointed at outcrops. The joints which strike east-north-east and dip nearly vertically have been identified in some places.

(3) Geohydrology

Alluvial sediments, hick insitu sediments of the Pleistocene age and the weathered bedrocks have a potential for shallow ground water that can be extracted through dug wells. Most of the shallow wells in use consist of unprotected wells and are liable to get polluted from surface drainage.

Fractured zones in the Precambrian rocks can be introduced as deep aquifers. More than 80 deep boreholes have been constructed in and around the Extension area in Integrated Rural Development Program. A majority of these deep wells yield small quantity of water (less than 25 liters/minute) and display higher electrical conductivity (more than 2,500 micro mhos/cm) and higher concentration of fluorides (more than 1,500 ppb) than WHO standards for drinking water.

(4) Walawe bridge site

The overburden is composed mainly of silty sand or sand (very fine to medium-grained). There shall be certain possibility to place the whole bridge base directly on the weathered bedrocks, if an open-cut excavation for the abutments and piers would extend more than 5 m from the original ground surface.

(5) Water intake weir sites on the Timbolketiya river

The overburden is composed mainly of silty sand and sandy silt at the both sites of the Andlu Ganga and the Timbolketiya Ganga. At the both sites, there shall be certain possibility to place the whole weir base directly on the fresh or weathered bedrocks, if an open-cut excavation for the weir body extend more than 4 m from the original ground surface.

(6) Foundation of canals and tanks

The canals and tanks shall be constructed on the rocks of the Vijayan Series and the deposits of the Pleistocene and Recent age. The overburden is composed mostly of brown to reddish brown silty sand and reddish brown gravelly silt. The overburden varies in thickness from 0 m to as much as 6 m in the Extension area. They are commonly thinner (less than 2 m)at the ridge and thicker (more than 3 m) in the valley.

Below the overburden the bedrock has weathered down into dense granular tight layers and granular sandy material with some silt. It seems that weathered bedrock is thinner (0 to 1.5 m) at the ridge and thicker (more than 3 m) in the valley. In many places along the ridge, fresh rocks of the Precambrian age are exposed. The weathered rocks can be scraped by hydraulic ripper.

The canal of which maximum depth will be approximately 5 m could be so designed to have a cut slope of not steeper than 1: 1.5 where ordinary sandy soils are developed. It could be necessary to take proper measure to protect the steep cut slope from the potential failures caused by the erosion.

The permeability test results of sandy soils show that the coefficients of permeability being less than 1 x 10^{-5} (cm/s) are low enough for the canal. But it seems that the coefficients of permeability of the weathered gneiss are much higher than those of sandy soils. Therefore the cut slope and bottom of canal shall be protected from the potential seepage by such means as concrete lining.

The embankment shall be founded on the sandy soils which will appear more often than the clayey soils throughout the Extension area. These soils have sufficient bearing capacity for the embankments, but are susceptible to erosion against seepage. Therefore those soils shall be treated properly by such means as a thorough blending with clayey materials, or the bottom width of the foundation shall satisfy the required creep length to withstand a piping phenomenon.

(7) Earth materials for canal embankment

According to the particle size test and the atterberg limits test most of the soil samples in the Extension area are conceived to be suitable for embankment bulk fill materials and core materials.

The shrinkage factor (the linear shrinkage) indicates that the soils will have a high potential of volume change.This may result in cracking in the embankments when they are dried.

The permeability being less than 1 x 10^{-5} (cm/s) is low enough for this type of embankment. This result, however, seems to be uncertain because of few samples.

The soils having high swelling potential may not exist in the Extension area, according to the swelling results obtained through CBR tests and one dimensional swell or settlement potential tests.

(8) Concrete aggregates

There are considerable sand deposits along the Walawe river that could be used for concrete. The sands are fine to coarsegrained,and contain a very small amount of silt fraction. They are conceived to be good sand materials for concrete aggregate.

The aggregate crushing values of rock materials (gneisses) indicate that the materials are not so hard for concrete aggregate to be used for high strength concrete such as concrete wearing surface of the road. The materials, however, are hard enough for concrete aggregate to be used for other concrete. Charnockite of the Highland Series is conceived to be a good rock material for concrete aggregate and riprap rock, and can be designated as alternative rock material but costly because of long haulage.

(9) Road construction materials

The swellings of sandy soils obtained through CBR tests for 5samples are less than 0.6 mm, which are regarded favorable as a subgrade of road. The road embankment will be made mainly of the Pleistocene deposits nearby the road construction work site because the pleistocene soils indicate more than 3% of CBR values except T-11. The road metalling materials, however, shall be borrowed from the sources such as charnockite of the Highland Series or gneisses of the Vijayan Series, because the Pleistocene soils show low CBR values.

5.5.2 Recommendations for further investigation

(1) Objectives

In order to clarify the questions raised in the fore-going sections and to establish the development plan, a comprehensive investigation should be executed in a future. The items to be investigated are as follows.

1) Subsoil conditions at the proposed Walawe bridge site and water intake weir sites on the Timbolketiya river
2) Subsoil conditions along the alignments of the canal embankments
3) Earth material
4) Concrete aggregate
5) Road construction material

(2) Investigation method to be applied

1) The bridge and water intake structures are to be placed on a stratum having a sufficient bearing capacity. The soil strata and weathered bedrocks on the proposed axis are to be carefully investigated by means of rotary core drilling. It is necessary to conduct drilling until fresh rock below the zone of weathered material has been encountered. The bearing capacity of the soil strata and weathered bedrocks are to be studied by means of standard penetration test and laboratory shear strength tests for undisturbed samples.

2) The embankments and canals are to be placed mostly on superficial strata of the Pleistocene sediments and on the rocks of the Vijayan Series after stripping or clearing, as high bearing capacity is not required. Sandy strata and the weathered bedrocks,however, are to be removed or modified to assure relatively low permeability to eliminate a piping phenomenon in the embankments. Thus the shallow subsoil conditions are to be detected by means of machine auger borings, the seismic prospecting method, the core drillings and test pits. The bearing capacity is to be estimated through the same method as the bridge. The permeability of each stratum and the weathered bedrock is to be estimated by means of field permeability test in the drilling holes and the laboratory permeability test for undisturbed samples.

3) The engineering properties of earth materials which shall have appropriate shear strength, low permeability, piping resistivity, workability during construction, are to be studied through the laboratory tests by using undisturbed and disturbed samples obtained from machine auger borings, the core drillings and the test pits.

4) The available quantities of the rock materials aggregates in the quarry sites are to be investigated by means of the detailed geological survey and the core drillings, and the qualities are to be studied by laboratory tests for the rock samples obtained from the core drillings and the quarry sites.

5) The road metalling materials are to be studied in a similar manner as the rock materials.

References

1) Cooray, P.G. (1967) Geology of Ceylon. National Museums of Ceylon Publication, 324 p.

2) Cooray, P.G. (1982) Geological Map of Sri Lanka (Ceylon).

3) Department of Mineralogy, Sri Lanka (1953) Provisional Geological Map of Ceylon.

4) Engineering Consulting Inc., U.S.A. (1962) Technical Report, Uda Walawe Project, Development of the Walawe Ganga Basin. Ministry of Agriculture, Lands Irrigation and Power, Irrigation Department, p.1-17.

5) Geological Survey Department, Sri Lanka (1964) Geological Map of Timbolketiya.

6) Geological Survey Department, Sri Lanka (1964) Geological Map of Ambalantota.

7) Geological Survey Department, Sri Lanka(1982) Geological Map of Sri Lanka.

8) Geological Survey Department, Sri Lanka (1982) Structural Map, Sri Lanka.

9) Geological Survey Department, Sri Lanka (1983) Metamorphic Map, Sri Lanka.

10) Geological Survey Department, Sri Lanka (1983) Mineral Resources Map, Sri Lanka.

11) Harath J.W. (1885) Economic Geology of Sri Lanka. Natural Resources, Energy & Science Authority of Sri Lanka, 207 p.

12) National Water Supply and Drainage Board (1986) District Plan on Drinking Water Supply and Sanitation, Hambantota District. Ministry of Plan Implementation, pl-225.

13) Photographic Survey Corporation, Limited, Canada (1960) A Report on a Reconnaissance Survey of the Resources of the Walawe Ganga Basin, Ceylon. A Canada-Ceylon Colombo Plan Project, p.1-327.

14) River Valleys Development Board (1968) Walawe Soil Map.

15) Water Resources Board (?) Log of Tube Well. 230p.

TABLES

Table A5.4-1 LIST OF SOIL SAMPLES

Location	Sample	Depth	Wn	Gs	Ps	At	Sf	Com	Per	CBR	Sw
Andlu Ganga(R)	T- 1	-1.0m	1*	1*	1	1	1	1	1	0	0
Andlu Ganga(L)	T- 2	-1.1m	1*	1*	1	1	1	1	1	0	0
Timbolketiya(L)	T-4(1)	-2.0m	0	1	1	1	1	1	1	0	0
	T-4(2)	-2.9m	1*	1*	1	1	1	1	1	0	0
Bridge site(L)	T-5(1)	-2.9m	1*	0	1	1	1	1	1	0	0
	T-5(2)	-3.7m	1*	0	1	1	1	1	1	0	0
	T-5(3)	-1.1m	0	1	1	1	0	1	1	0	0
Bridge site(R)	T- 6	-1.5m	0	1	1	1	1	1	1	0	0
Bedigantota	T- 7	-1.3m	0	1	1	1	1	1	1	0	0
Mahabelgoda	T- 8	-1.7m	1*	1*	1	1	1	1	0	0	0
Andara Wewa	T-9(1)	-1.3m	1*	0	1	1	1	1	0	0	0
	T-9(2)	-2.5m	1*	0	1	1	1	1	0	0	0
Burutakanda	T-11	-0.3m	0	1	1	1	1	1	0	1	1
Baruthankanda	T-12	-0.5m	0	1	1	1	1	1	0	1	1
Siyambalagas Wewa	T-13	-0.3m	0	1	1	1	1	1	0	0	0
Koholankala	T-14	-0.3m	0	1	1	1	1	1	0	0	0
Uda Beragama	T-15	-0.4m	0	1	1	1	1	1	0	1	1
Galloville	T-16	-0.3m	0	1	1	1	1	1	1	0	0
Karuwala Wewa	T-17	-0.3m	0	1	1	1	1	1	0	0	0
Ballagas Wewa	T-18	-0.3m	0	1	1	0	0	1	0	1	1
Buthagame Wewa	T-19	-0.3m	0	1	1	1	0	1	0	0	0
Karowagas Wewa	T-20	-0.4m	0	1	1	1	0	1	0	0	0
Bedigantota	T-21(1)	-0.3m	0	1	1	1	1	1	0	0	0
	T-21(2)	-0.4m	0	0	0	0	0	0	0	1	1
Hondawelpokuna	T-22(1)	-0.3m	0	1	1	1	1	1	0	0	0
	T-22(2)	-0.4m	0	0	0	0	0	0	0	1	0
Hangarangel Wewa	T-23	-0.3m	0	1	1	1	1	1	0	0	0
Hodanaga	T-24(1)	-0.3m	0	1	1	1	1	1	1	0	0
Total			8	22	26	25	22	26	11	6	5

Note:

Wn: Moisture content test
Gs: Specific gravity test
Ps: Particle size test
At: Atterberg limits test (LL,PL)

Sf: Shrinkage factors test
Com: Compaction test
Per: Permeability test (95%Compaction)
CBR: CBR test
Sw: Swelling test

* : Undisturbed sample

(R): Right bank
(L): Left bank

Table A5.4-2 LIST OF CONCRETE AGGREGATE SAMPLES

Location	Sample No.	Sample	Gs	Ab	Gr	ACV	10%Fine
Bridge site	S-1	Sand	1	1	1	0	0
Bolana	S-2	Sand	1	1	1	0	0
Suriyawewa	R-1	Gneiss	1	1	0	1	1
Uda Beragama	R-2	Gneiss	1	1	0	1	1
Total			4	4	2	2	2

Note:

Gs: Specific gravity test
Ab: Absorption test
Gr: Gradation test
ACV: Aggregate crushing value
10%Fine: 10%Fine rock test

Table A5.4-3 SUMMARY OF LABORATORY SOIL TESTS (1/4)

Sample No.	T-1	T-2	T-4(1)	T-4(2)	T-5(1)	T-5(2)	T-5(3)	T-6
Location	Andlu Ganga(R)	Andlu Ganga(L)	Timbolke-tiya(L)	Timbolke-tiya(L)	Bridge site(L)	Bridge site(L)	Bridge site(L)	Bridge site(R)
Depth (m)	-1.0	-1.1	-2.0	-2.9	-2.9	-3.7	-1.1	-1.5
Particle size								
Clay (%)	5	7	7	10	11	12	7	10
Silt (%)	15	27	21	36	23	23	21	62
Fine sand (%)	76	53	62	44	59	65	66	28
Medium sand (%)	4	8	10	10	4	-	6	-
Coarse sand (%)	-	1	-	-	2	-	-	-
Fine gravel (%)	-	2	-	-	1	-	-	-
Coarse gravel (%)	-	2	-	-	-	-	-	-
Pass No.4 (%)	100	96	100	100	99	100	100	100
Pass No.200 (%)	20	34	28	46	34	35	28	72
Atterberg limits								
LL (%)	*	28	*	31	25	24	*	36
PL (%)	*	21	*	18	20	21	*	23
PI (%)	*	7	*	13	5	3	*	13
Classification	SM	SM	SM	SC	SC	SC	SM	CL/ML
Wn-Moisture content (%)	19.9	22.0	-	21.0	16.5	12.9	-	-
Gs-Specific gravity	2.69	2.57	2.64	2.70	-	-	2.71	2.63
Sf-Shrinkage factor (%)	*	19.8	*	20.4	18.8	21.2	*	23.0
Compaction								
OMC (%)	16.5	15.8	13.7	15.5	13.8	16.0	14.3	21.5
MDD (g/cm3)	1.753	1.777	1.804	1.788	1.834	1.762	1.764	1.546
Permeability at 95% MDD (cm/s)	8.640 x 10^{-8}	5.867 x 10^{-8}	3.789 x 10^{-7}	8.012 x 10^{-8}	2.832 x 10^{-8}	2.229 x 10^{-7}	1.232 x 10^{-6}	7.249 x 10^{-9}
CBR at 95% MDD								
Soaked 2.5 mm (%)								
Soaked 5.0 mm (%)								
Unsoaked 2.5 mm (%)								
Unsoaked 5.0 mm (%)								
Swelling (mm)								
One dimensional swell or settlement potential test								
Specific gravity								
Initial sample height (cm)								
Final sample height (cm)								
Initial void ratio								
Final void ratio								

*: Cannot be performed

Table A5.4-3 SUMMARY OF LABORATORY SOIL TESTS (2/4)

Sample No.	T-7	T-8	T-9(1)	T-9(2)	T-11	T-12	T-13	T-14
Location	Bedigan-tota	Mahabel-goda	Andara Wewa	Andara Wewa	Buruta-kanda	Baruthan-kanda	Siyambal-agas Wewa	Koholan-kala
Depth (m)	-1.3	-1.7	-1.3	-2.5	-0.3	-0.5	-0.3	-0.3
Particle size								
Clay (%)	12	4	24	6	14	25	32	14
Silt (%)	29	5	24	15	35	21	28	32
Fine sand (%)	26	13	26	43	29	33	28	30
Medium sand (%)	24	49	25	29	21	18	12	19
Coarse sand (%)	7	26	1	7	1	2	-	2
Fine gravel (%)	2	3	-	-	-	1	-	3
Coarse gravel (%)	-	-	-	-	-	-	-	-
Pass No.4 (%)	98	97	100	100	100	100	100	97
Pass No.200 (%)	41	9	48	21	49	46	61	46
Atterberg limits								
LL (%)	33	21	40	26	36	32	43	39
PL (%)	20	18	21	17	21	14	19	21
PI (%)	13	3	19	9	15	18	24	18
Classification	SC	SC	SC	SC	SC	SC	CL	SC
Wn-Moisture content (%)	-	3.6	10.5	15.8	-	-	-	
Gs-Specific gravity	2.70	2.58	-	-	2.57	2.74	2.62	2.63
Sf-Shrinkage factor (%)	18.5	17.9	14.8	21.1	15.0	12.6	14.3	14.2
Compaction								
OMC (%)	14.8	9.2	15.5	13.0	15.5	14.0	16.5	14.9
MDD (g/cm3)	1.772	1.810	1.754	1.878	1.778	1.786	1.719	1.805
Permeability at 95% MDD (cm/s)	1.604 x 10^{-8}							
CBR at 95% MDD								
Soaked 2.5 mm (%)					3.19	3.82		
Soaked 5.0 mm (%)					2.61	3.17		
Unsoaked 2.5 mm (%)					2.91	7.93		
Unsoaked 5.0 mm (%)					2.61	6.77		
Swelling (mm)					0.551	0.322		
One dimensional swell or settlement potential test								
Specific gravity						2.64		
Initial sample height (cm)						2.0		
Final sample height (cm)						1.8916		
Initial void ratio						0.580		
Final void ratio						0.503		

-: Cannot be performed

Table A5.4-3 SUMMARY OF LABORATORY SOIL TESTS (3/4)

Sample No.	T-15	T-16	T-17	T-18	T-19	T-20	T-21(1)	T-21(2)
Location	Uda Bera-gama	Gallovi-lle	Karuwala Wewa	Ballagas Wewa	Buthagame Wewa	Karowagas Wewa	Bedigan-tota	Bedigan-tota
Depth (m)	-0.4	-0.3	-0.3	-0.3	-0.3	-0.4	-0.3	-0.4
Particle size								
Clay (%)	6	24	24	14	20	16	16	
Silt (%)	7	25	21	30	43	22	35	
Fine sand (%)	5	31	41	30	29	36	29	
Medium sand (%)	6	17	13	24	8	23	20	
Coarse sand (%)	37	3	1	2	-	2	-	
Fine gravel (%)	35	-	-	-	-	1	-	
Coarse gravel (%)	4	-	-	-	-	-	-	
Pass No.4 (%)	61	100	100	100	100	99	100	
Pass No.200 (%)	14	49	45	44	63	38	51	
Atterberg limits								
LL (%)	41	35	30	-	41	28	41	
PL (%)	25	21	18	-	19	15	20	
PI (%)	16	14	12	-	22	13	21	
Classification	SC	SC	SC	SC	CL/SC	SC	CL/SC	
Wn-Moisture content (%)	-	-	-	-	-	-	-	
Gs-Specific gravity	2.66	2.56	2.55	2.68	2.69	2.64	2.57	
Sf-Shrinkage factor (%)	18.6	15.2	15.8	-	-	-	16.1	
Compaction								
OMC (%)	13.1	12.7	13.8	11.6	14.7	12.9	16.5	
MDD (g/cm3)	1.897	1.874	1.842	1.903	1.799	1.890	1.753	
Permeability at 95% MDD (cm/s)		3.093 x 10^{-9}						
CBR at 95% MDD								
Soaked 2.5 mm (%)	4.96			5.86				6.67
Soaked 5.0 mm (%)	4.92			6.44				6.25
Unsoaked 2.5 mm (%)	4.25			5.68				5.68
Unsoaked 5.0 mm (%)	4.13			5.81				5.40
Swelling (mm)	0.07			0.057				0.106
One dimensional swell or settlement potential test								
Specific gravity	2.69			2.69				2.70
Initial sample height (cm)	2.0			2.0				2.0
Final sample height (cm)	1.9326			1.893				1.8698
Initial void ratio	0.51			0.572				0.722
Final void ratio	0.460			0.487				0.610

*; Cannot be performed

Table A5.4-3 SUMMARY OF LABORATORY SOIL TESTS (4/4)

Sample No.	T-22(1)	T-22(2)	T-23	T-24(1)
Location	Hondawel-pokuna	Hondawel-pokuna	Hangaran-gel Wewa	Hondanaga
Depth (m)	-0.3	-0.4	-0.3	-0.3
Particle size				
Clay (%)	12		26	14
Silt (%)	35		32	43
Fine sand (%)	31		24	23
Medium sand (%)	20		17	14
Coarse sand (%)	2		1	6
Fine gravel (%)	-		-	-
Coarse gravel (%)	-		-	-
Pass No.4 (%)	100		100	100
Pass No.200 (%)	47		58	57
Atterberg limits				
LL (%)	36		35	38
PL (%)	19		19	22
PI (%)	17		16	16
Classification	SC		CL/SC	CL
Wn-Moisture content (%)	-		-	-
Gs-Specific gravity	2.55		2.61	2.60
Sf-Shrinkage factor (%)	15.4		16.1	15.8
Compaction				
OMC (%)	14.5		15.5	17.8
MDD (g/cm3)	1.818		1.759	1.722
Permeability at 95% MDD (cm/s)				1.266 x 10^{-8}
CBR at 95% MDD				
Soaked 2.5 mm (%)		4.97		
Soaked 5.0 mm (%)		4.26		
Unsoaked 2.5 mm (%)		2.70		
Unsoaked 5.0 mm (%)		2.84		
Swelling (mm)		-		
One dimensional swell or settlement potential test				
Specific gravity				
Initial sample height (cm)				
Final sample height (cm)				
Initial void ratio				
Final void ratio				

*: Cannot be performed

Table A5.4-4 SUMMARY OF LABORATORY CONCRETE AGGREGATE TESTS

Sample No.	S-1	S-2	R-1	R-2
Location	Bridge site	Bolana	Suriyawewa	Uda Beragama
Material	Sand	Sand	Gneiss	Gneiss
Fine aggregate				
Sieve analysis; Passing %				
U.S.No.4 (4.75mm)	97.9	98.4		
U.S.No.8 (2.362mm)	88.8	92.4		
U.S.No.16 (1.188mm)	53.4	72.4		
U.S.No.30 (0.589mm)	16.9	40.4		
U.S.No.50 (0.295mm)	1.8	13.5		
U.S.No.100 (0.147mm)	-	1.8		
U.S.No.200 (0.074mm)	-	0.9		
Specific gravity				
Dry basis	2.55	2.64		
SSD basis	2.58	2.67		
Water absorption (%)	1.1	1.0		
Coarse aggregate				
Water absorption (%)				
38.1-19.05mm			0.4	0.73
19.05-9.52mm			1.1	0.93
9.52-4.75mm			1.6	1.3
Specific gravity (SSD basis)				
38.1-19.05mm			2.75	2.65
19.05-9.52mm			2.68	2.65
9.52-4.75mm			2.70	2.65
Aggregate crushing value (%)			34.5	35
10 % Fines value (%)			34.5	35

FIGURES

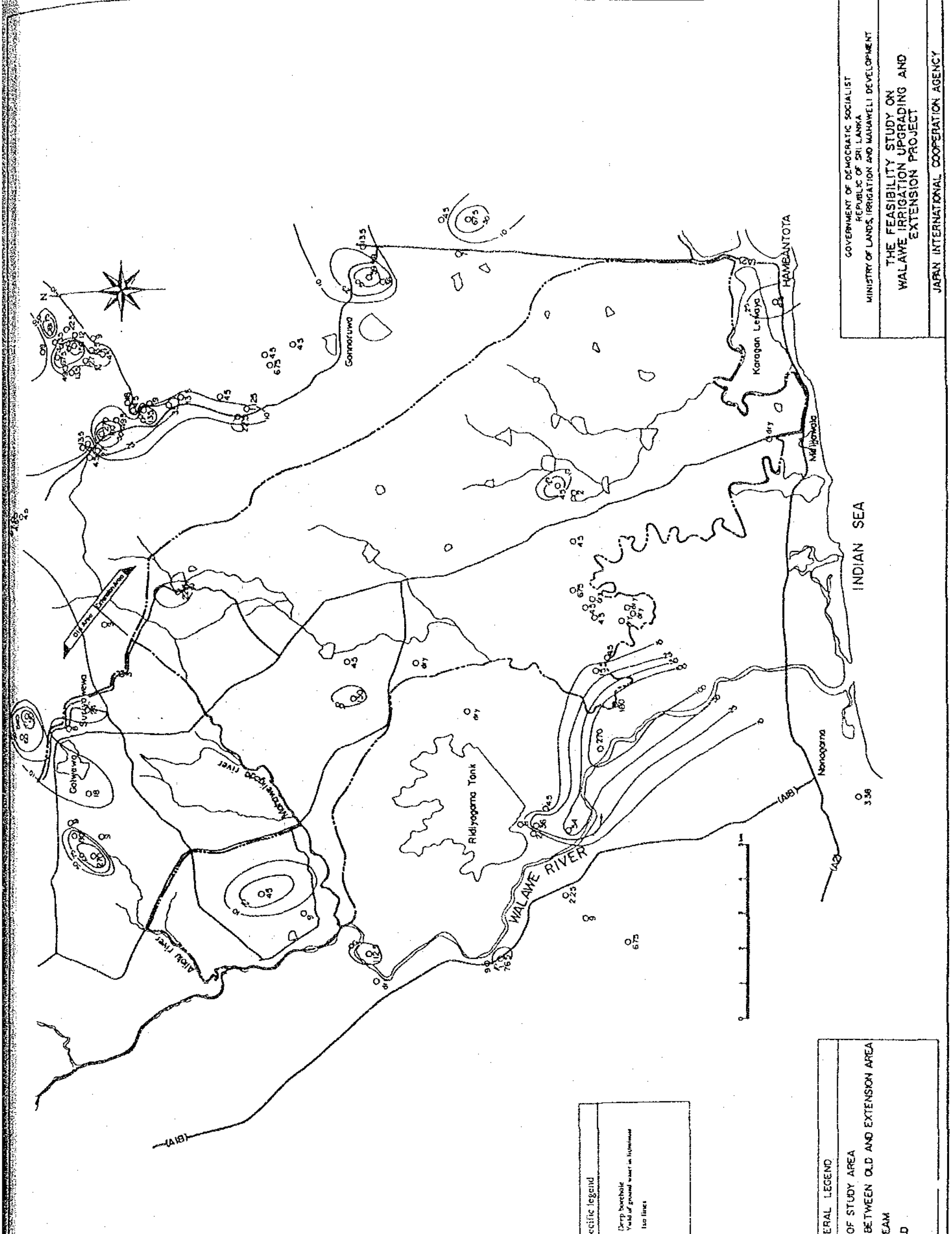

Fig. A5.2-1 YIELD OF GROUND WATER IN DEEP IRDP BOREHOLES

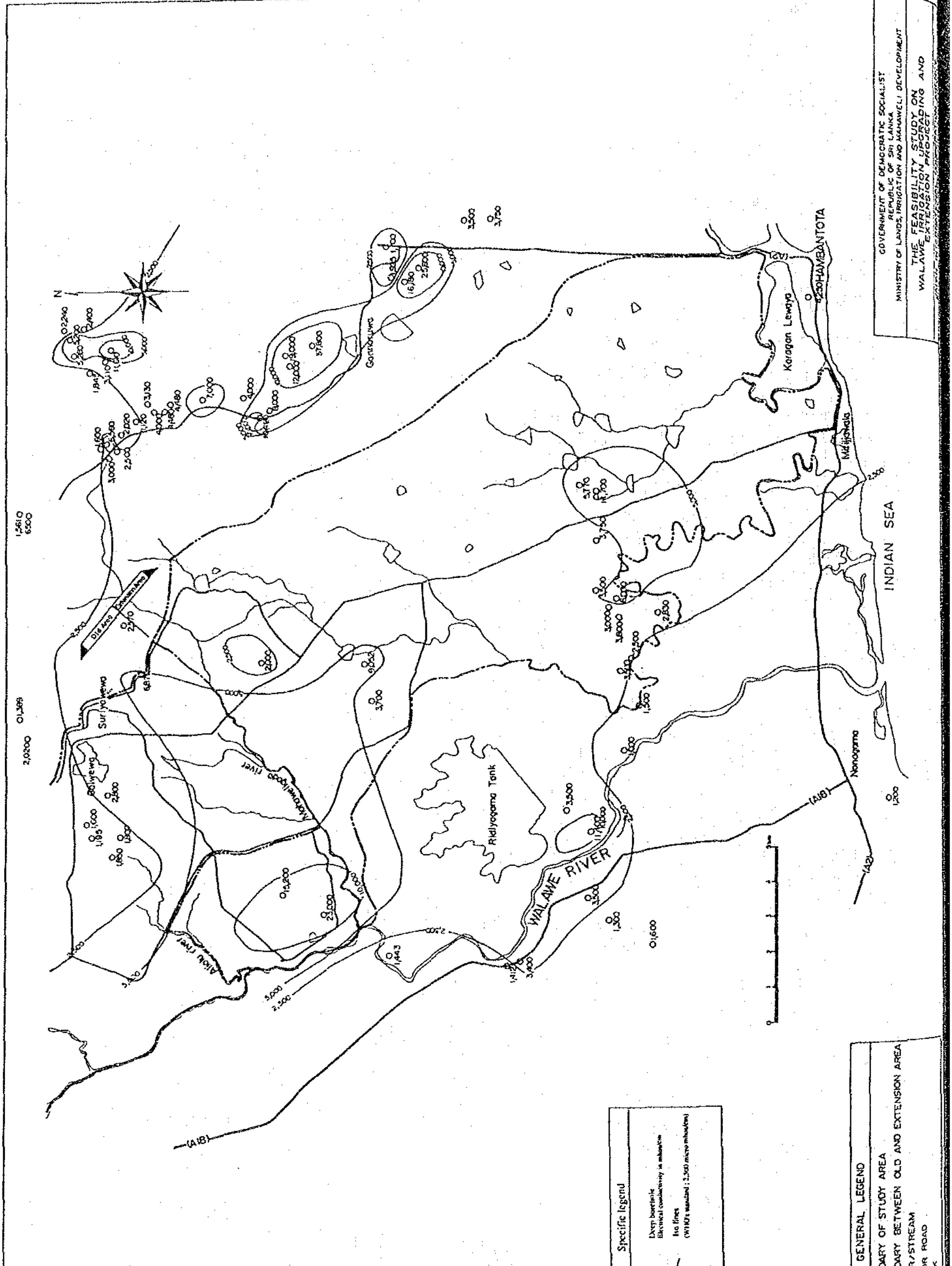

Fig. A5.2-2 DISTRIBUTION OF ELRCTRICAL CONDUCTIVITY OF GROUND WATER IN DEEP IRDP BOREHOLES

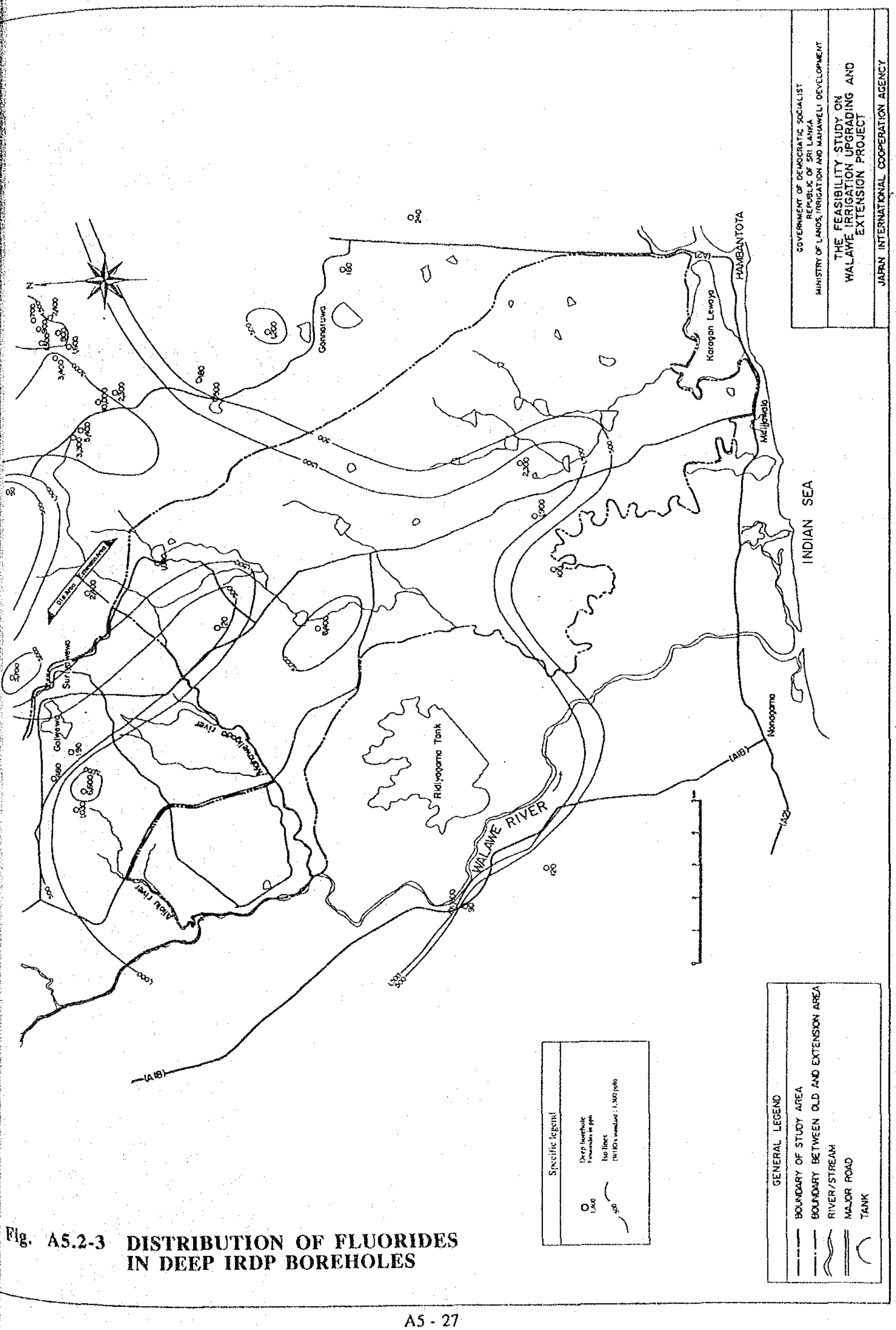

Fig. A5.2-3 DISTRIBUTION OF FLUORIDES IN DEEP IRDP BOREHOLES

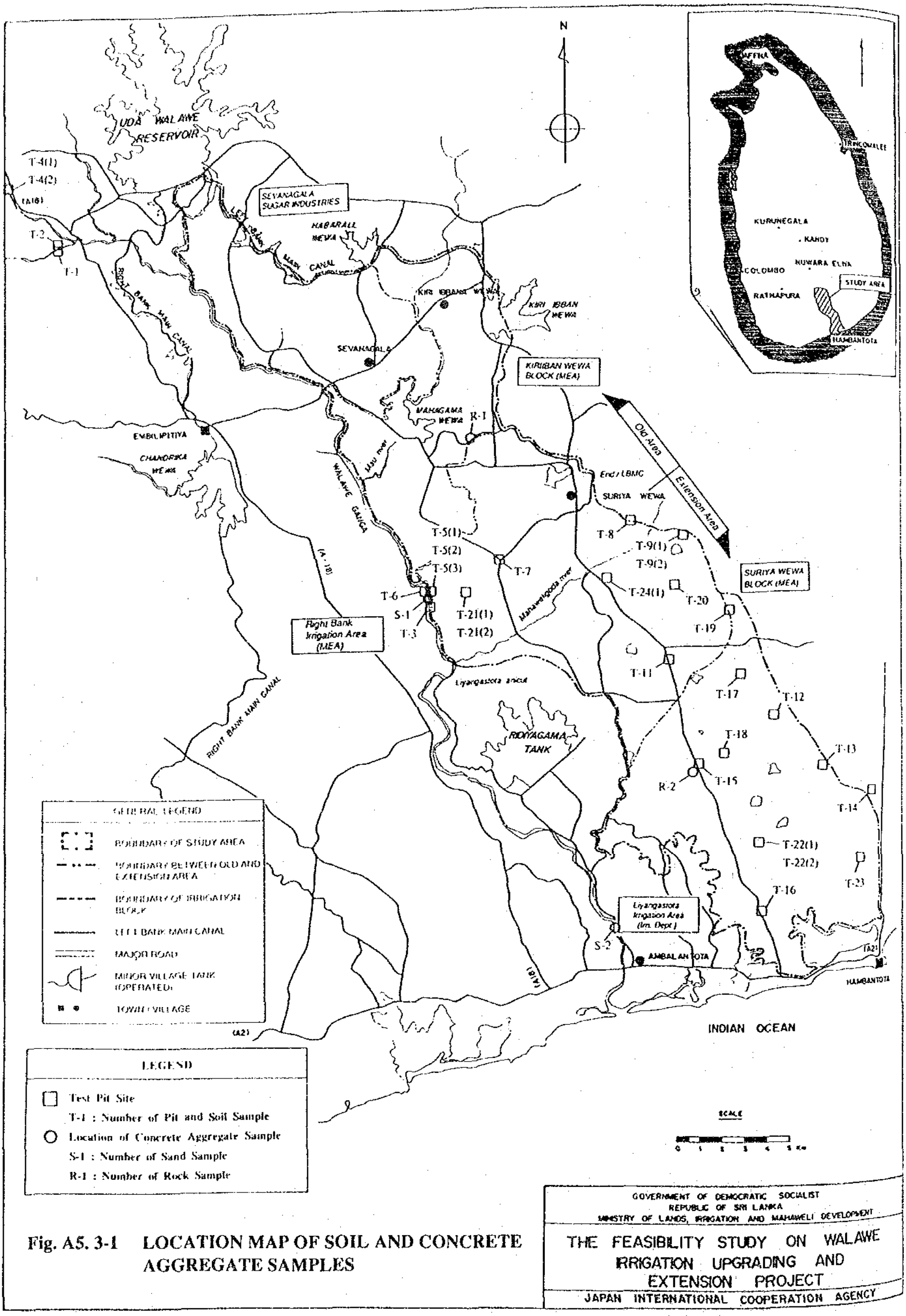

Fig. A5. 3-1 LOCATION MAP OF SOIL AND CONCRETE AGGREGATE SAMPLES

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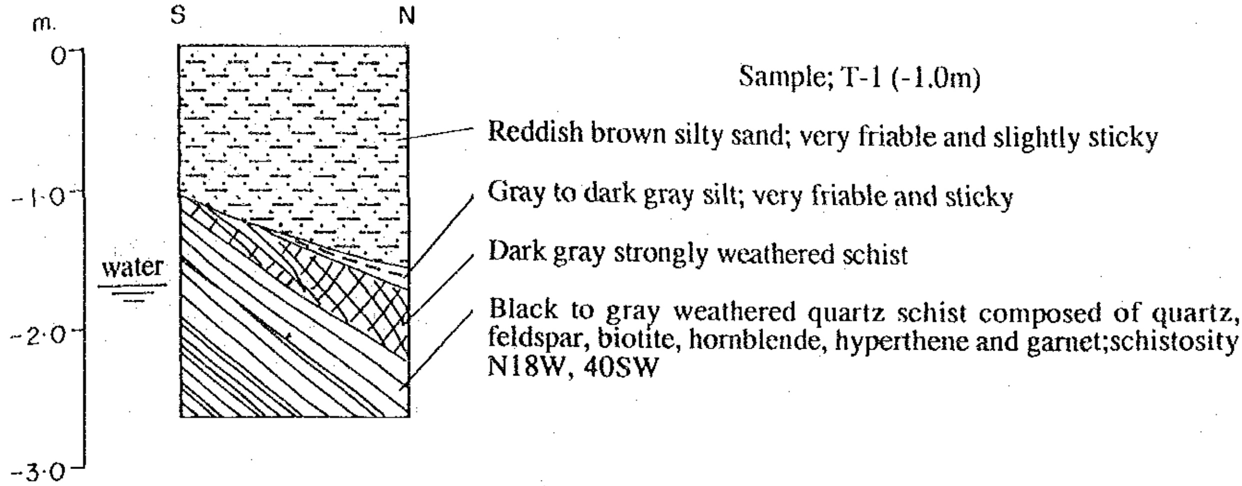
T-1 Andlu Ganga (Right Bank)



T-2 Andlu Ganga (Left Bank)

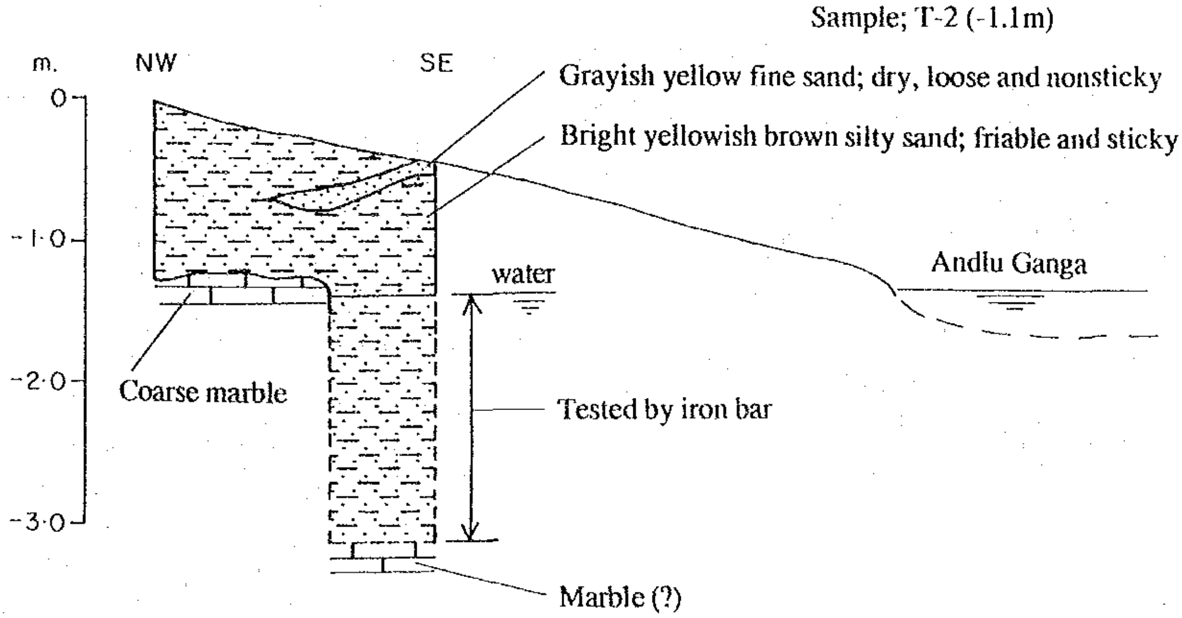


Fig. A5. 3-2 LOGS OF TEST PIT (1/9)

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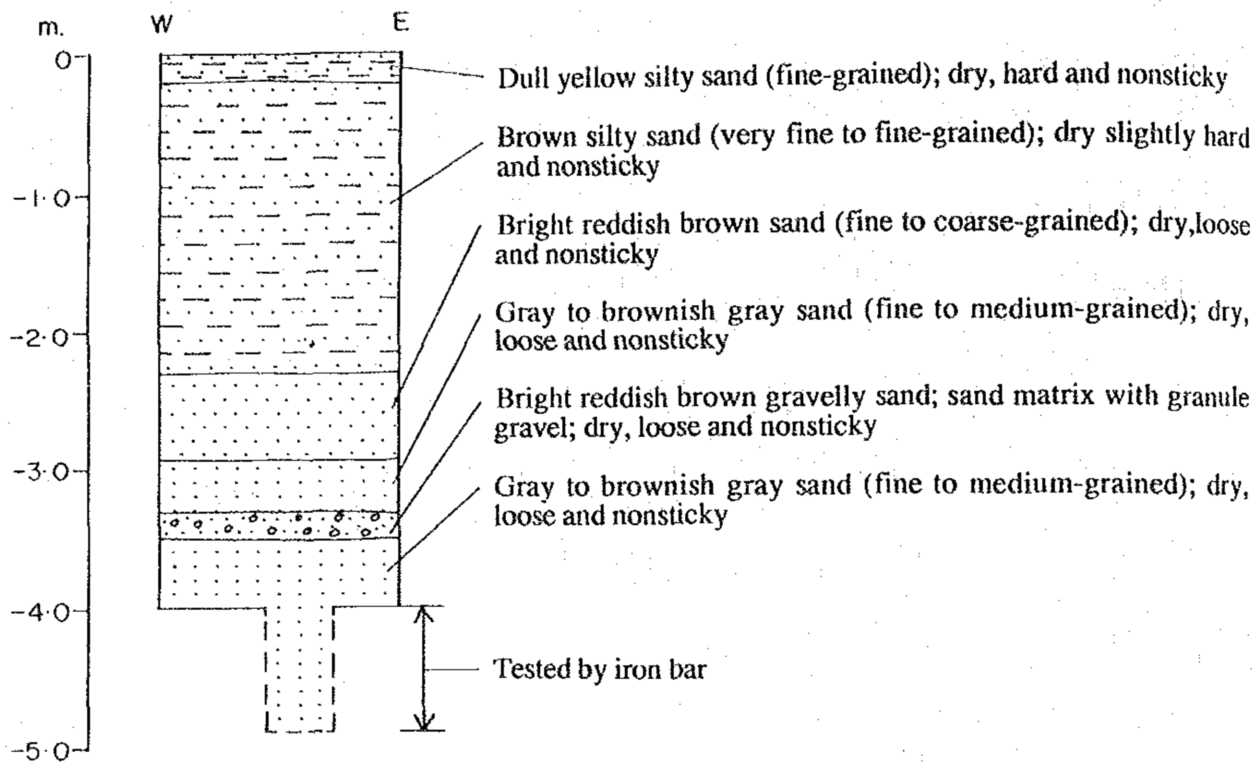
T-3 Bridge Site (Left Bank)



T-4 Upper Stream of Timbolketiya (Left Bank)

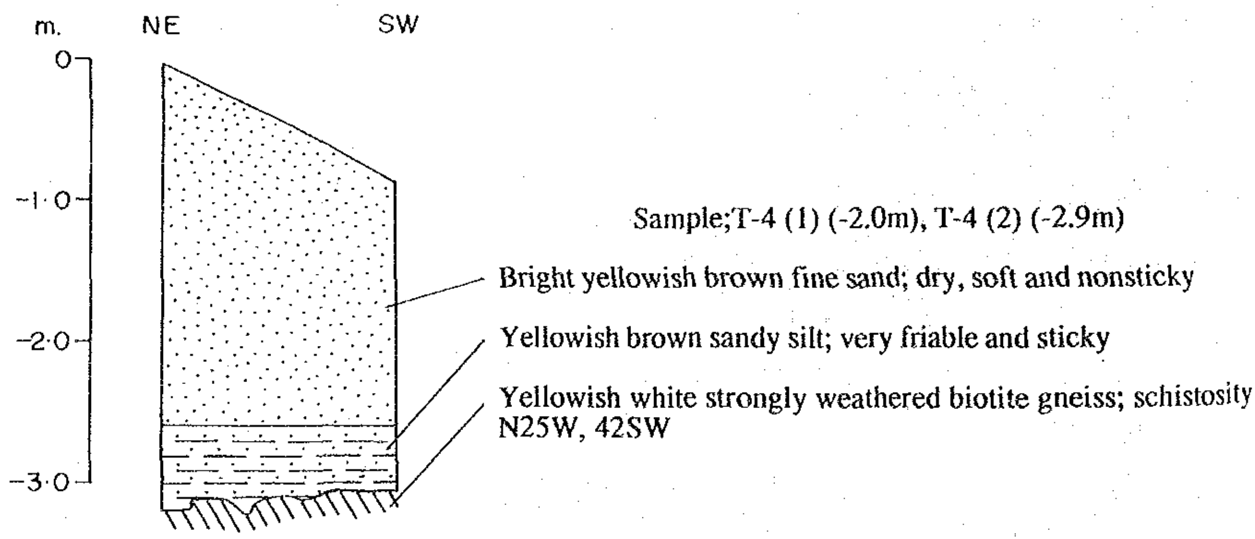


Fig. A5. 3-2 LOGS OF TEST PIT (2/9)

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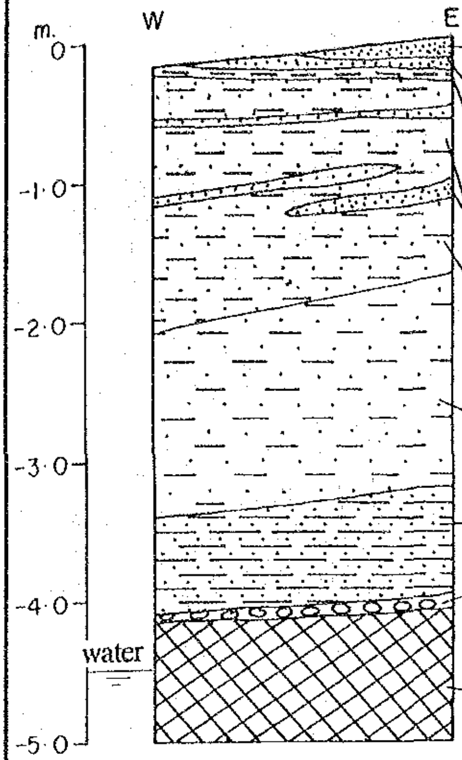
T-5 Bridge Site (Left Bank)

Sample;T-5 (1) (-2.9m), T-5 (2) (-3.7m), T-5 (3) (-1.1m)



Brown silty sand (very fine to fine-grained); dry, slightly hard and nonsticky

Bright yellowish brown fine sand; dry, slightly hard and nonsticky

Brown silt; dry, hard and nonsticky

Grayish yellow fine sand; dry, loose and nonsticky

Bright yellowish brown silty sand (very fine to fine-grained); dry, slightly hard and nonsticky

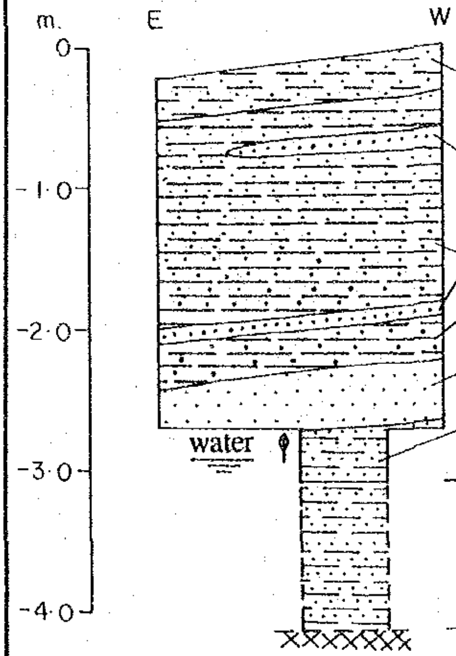
Brown silty sand (very fine to fine-grained); dry, hard and nonsticky

Reddish brown sandy silt; friable and slightly sticky

Reddish brown gravelly silt;silt matrix with sub-angular fragments of quartz and unweathered rock of pebble size (D=0.5-4cm); hard and slightly sticky

Dark reddish brown to bright reddish brown strongly weathered biotite gneiss

T-6 Bridge Site(Right Bank)



Sample; T-6 (-1.5m)

Dull reddish brown silty sand(very fine to fine-grained); dry, slightly hard and nonsticky

Bright yellowish brown very fine sand; dry, loose and nonsticky

Dull yellow orange sandy silt; dry, soft and nonsticky

Grayish orange fine sand;dry,loose and nonsticky

Dark brown sandy silt;abundant leaves;friable and slightly sticky

Tested by iron bar

Weathered rock (?)

Fig. A5. 3-2 LOGS OF TEST PIT (3/9)

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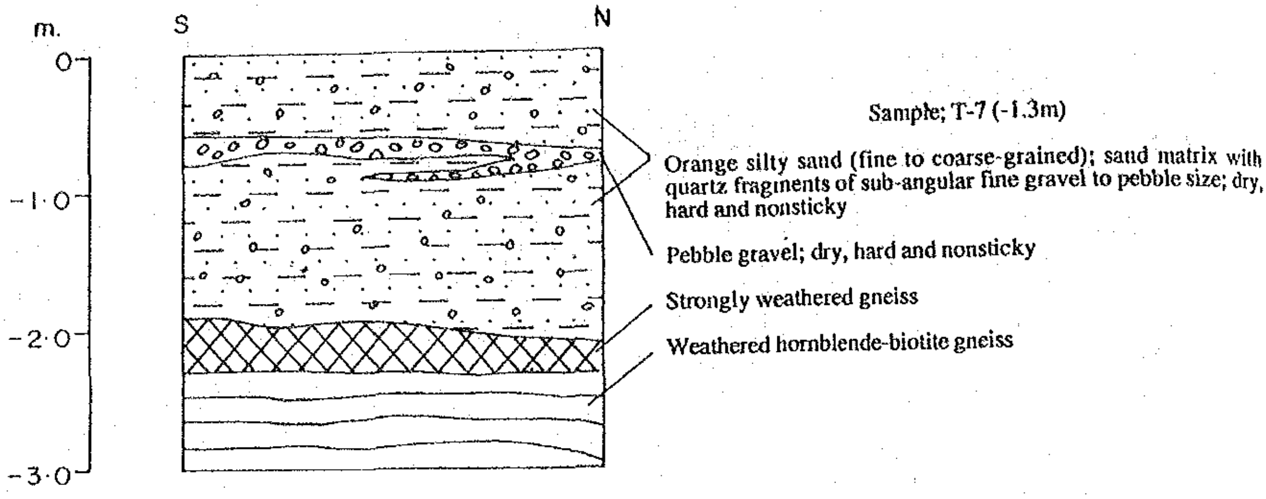
T-7 Bedigantota (Canal Wall)



T-8 Mahabelgoda

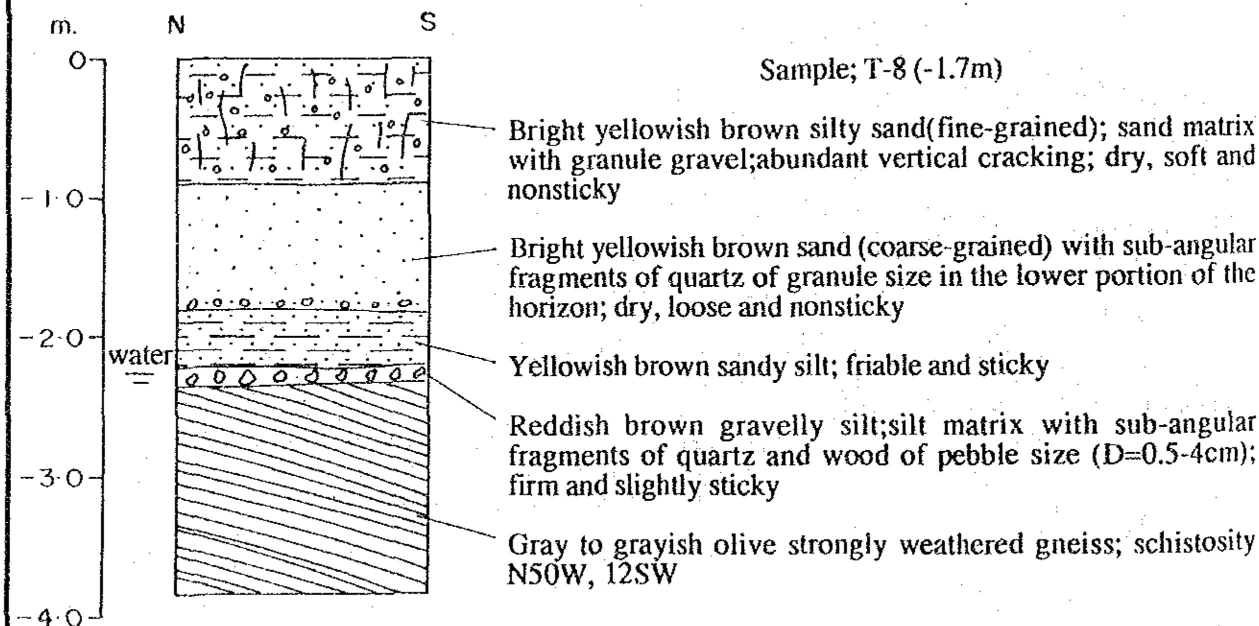


Fig. A5. 3-2 LOGS OF TEST PIT (4/9)

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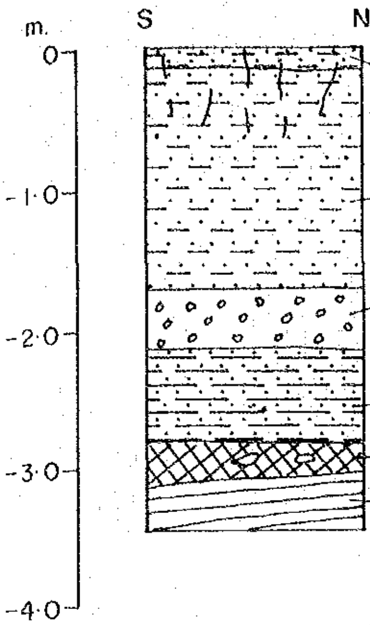
T-9 Andara Wewa



Sample;T-9 (1) (-1.3m), T-9 (2) (-2.5m)

Grayish brown silty sand (fine-grained); weak vertical cracking; dry, slightly hard and nonsticky

Bright brown silty sand (fine to coarse-grained); weak vertical cracking; dry,hard and nonsticky

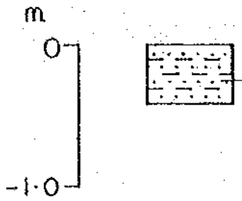
Reddish brown gravelly silt;silt matrix with sub-angular fragments of quartz,feldspar and garnet of granule size (D=1-3mm, max.D=3cm); dry, hard and nonsticky

Bright yellowish brown sandy silt;friable and slightly sticky

Strongly weathered biotite gneiss with fragments of feldspar

Weathered biotite gneiss

T-11 Burutakanda

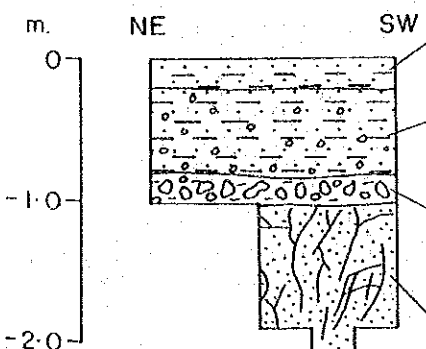


Sample; T-11 (-0.3m)

Reddish brown silty sand (fine-grained); sand matrix with a small amount of quartz fragments of granule size; dry, hard and nonsticky

T-12 Baruthankanda

Sample; T-12 (-0.5m)



Olive yellow silty sand (very fine to fine-grained); dry, very hard and nonsticky

Grayish olive silty sand matrix with angular and sub-angular fragments of quartz and unweathered rock of granule size; dry, very hard and nonsticky

Reddish brown gravelly silt;silt matrix with angular and sub-angular fragments of quartz and unweathered rock of pebble size (D=0.5-4cm); dry, very hard and nonsticky

Strongly weathered gneiss;cracking with black organic inclusions; dry, soft and nonsticky

Fig. A5. 3-2 LOGS OF TEST PIT (5/9)

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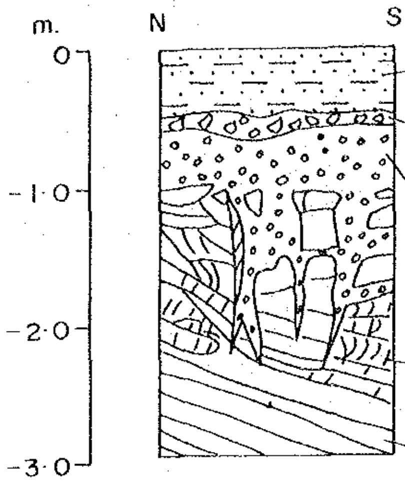
T-13 Siyambalagas Wewa

Sample; T-13 (-0.3m)



Dull reddish brown silty sand (very fine to fine-grained); dry, hard and nonsticky

Bright reddish brown gravelly silt;silt matrix with angular and sub-angular fragments of feldspar and quartz of pebble size (D=0.5-5cm); dry, very hard and nonsticky

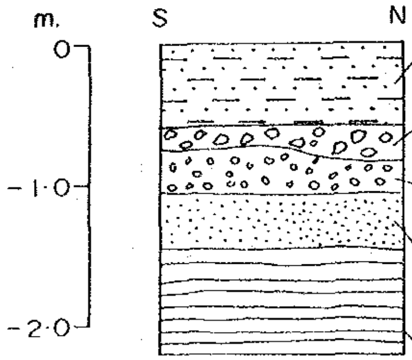
Reddish brown gravelly silt;silt matrix with sub-angular fragments of garnet,feldspar and quartz of granule size (D=0.5-1cm); dry, very hard and nonsticky

Light yellow orange to reddish brown strongly weathered biotite gneiss

Light yellow orange weathered biotite gneiss;schistosity N12E, 10SE

T-14 Koholankala

Sample; T-14 (-0.3m)



Bright reddish brown silty sand (very fine to fine-grained); dry, hard and nonsticky

Reddish brown gravelly silt;silt matrix with sub-angular fragments of quartz and garnet of pebble size (D=0.5-5cm); dry, hard and nonsticky

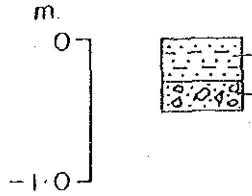
Dull reddish brown gravelly silt;silt matrix with sub-angular fragments of granule size (D=0.2-1cm); dry, hard and nonsticky

Bright reddish brown coarse sand (D=1-2mm); dry, hard and nonsticky

Light yellow orange strongly weathered biotite gneiss; schistosity N45W, 13NE

T-15 Uda Beragama

Sample; T-15 (-0.4m)



Reddish brown silty sand (very fine to fine-grained); dry, very hard and nonsticky

Reddish brown gravelly sand (very fine to fine-grained); sand matrix with sub-angular fragments of quartz of pebble size (D=0.5-3cm); dry, very hard and nonsticky

Fig. A5. 3-2 LOGS OF TEST PIT (6/9)

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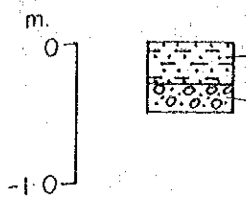
T-16 Galloville

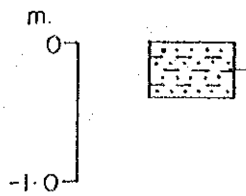


Sample; T-16 (-0.3m)

Reddish brown silty sand (fine to coarse-grained); dry, hard and nonsticky

Reddish brown gravelly sand (fine to coarse-grained); sand matrix with sub-angular fragments of quartz of pebble size (D=0.5-2cm); dry, very hard and nonsticky

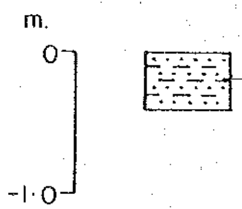
T-17 Karuwalá Wewa



Sample; T-17 (-0.3m)

Bright brown silty sand (very fine-grained); dry, slightly hard and nonsticky

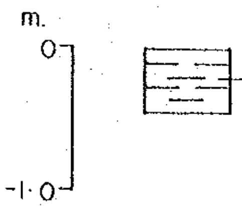
T-18 Ballagas Wewa



Sample; T-18 (-0.3m)

Reddish brown silty sand (fine to coarse-grained); dry, hard and nonsticky

T-19 Buthagame Wewa



Sample; T-19 (-0.3m)

Dark brown silt; dry, very hard and nonsticky

Fig. A5. 3-2 LOGS OF TEST PIT (7/9)

GOVERNMENT OF DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

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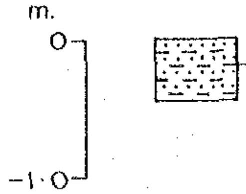
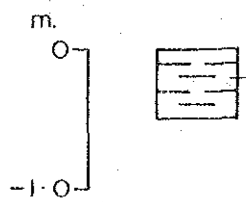
T-20 Karowagas Wewa



Sample; T-20 (-0.4m)

Dull reddish brown silty sand; dry, hard and nonsticky

T-21 Bedigantota

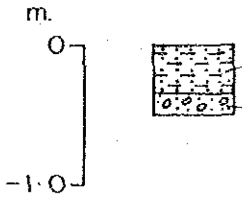


Sample; T-21 (1) (-0.3m), T-21 (2) (-0.4m)

Dark reddish brown silt; dry, very hard and nonsticky

T-22 Hondawelpokuna

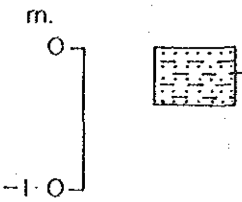
Sample; T-22 (1) (-0.3m), T-22 (2) (-0.4m)



Bright brown silty sand (fine-grained) with a small amount of quartz fragments of sub-angular fine gravel to pebble size;dry, hard and nonsticky

Bright brown gravelly sand (fine-grained); sand matrix with sub-angular fragments of quartz of pebble size (D=0.5-3cm): dry, hard and nonsticky

T-23 Hangarangel Wewa



Sample; T-23 (-0.3m)

Reddish brown silty sand (very fine to fine-grained); dry, hard and nonsticky

Fig. A5. 3-2 LOGS OF TEST PIT (8/9)

GOVERNMENT OF DEMOCRATIC SOCIALIST
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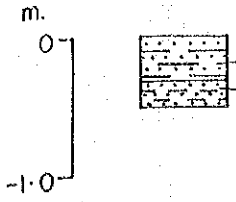
JAPAN INTERNATIONAL COOPERATION AGENCY

T-24 Hondanaga

Sample; T-24 (1) (-0.3m)



Reddish brown sandy silt;very firm and slightly sticky

Reddish brown silty sand (fine to coarse-grained); very firm and slightly sticky

Fig. A5. 3-2 LOGS OF TEST PIT (9/9)

GOVERNMENT OF DEMOCRATIC SOCIALIST
REPUBLIC OF SRI LANKA
MINISTRY OF LANDS, IRRIGATION AND MAHAWELI DEVELOPMENT

THE FEASIBILITY STUDY ON WALAWE IRRIGATION UPGRADING AND EXTENSION PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

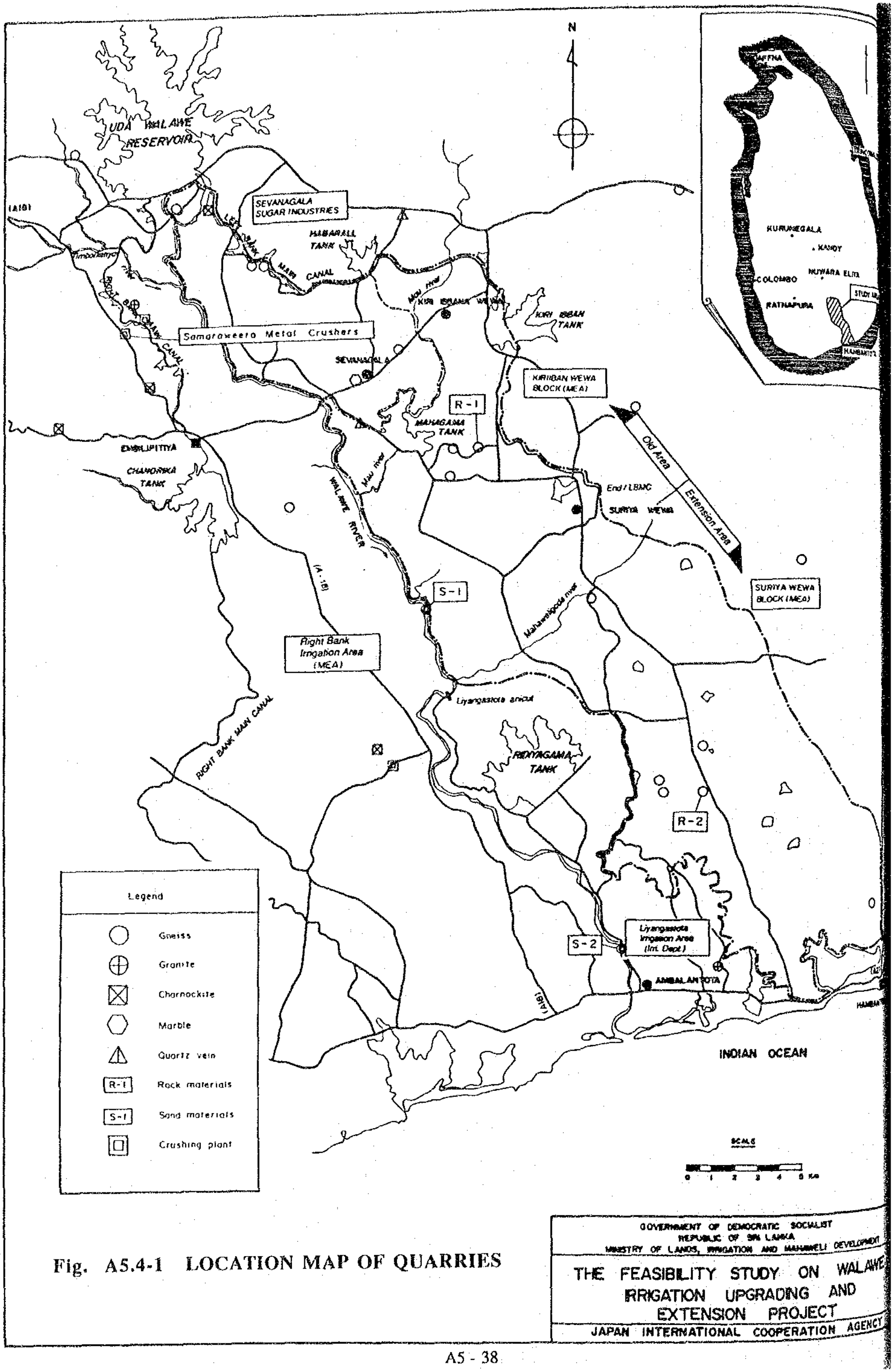


Fig. A5.4-1 LOCATION MAP OF QUARRIES

Annex - VI

Agriculture and Agro-economy

ANNEX VI AGRICULTURE AND AGRO-ECONOMY

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ANNEX VI AGRICULTURE AND AGRO-ECONOMY

6.1 National Economy and Regional Development Plans

6.1.1 National economy

The mid year population of Sri Lanka in 1991 has been provisionally estimated at 17.25 million, based on the population census of 1981 and an annual growth rate of 1.2%. The population density in Hambantota district is estimated at 206 persons per sq km, which is below the national density of 276. Population by age is shown in Table A6.1-1

Sri Lanka Labour Force Survey for the first quarter of 1990 estimates the economically active population of age 10 years and older to be 6.97 million. 5.96 million or 85.6% were employed and the rural sector showed a lower unemployment rate of 13.6% compared to 18.5% of the urban sector. Agriculture sector comprising agriculture, stock farming, fishery and forestry absorbed the larger share accounting for 47,8% of the labour force. Present employment status is shown in Tables A6.1-2 and A6.1-3

The growth rate of Gross National Product (GNP), estimated at Rs. 135.39 billion (constant 1982 price) in 1991, dropped to 4.7% from the previous years 6.2%. The sectoral performance of the GNP, shown in Table A6.1-4, indicate that the contribution of agricultural sector has declined during 1991 with growth rate of only 2.6% compared to previous years 8.8%. Nevertheless, the sector contributed 23% of the total GNP and will continue to play a vital role in the Sri Lanka economy.

Growth projections indicate an average rate of growth of around 5.8% during the next five years. It is estimated that a growth rate of around 8% is required if, by the end of the decade, both per capita income is to be doubled in real terms, and unemployment rate is to be reduced to a socially acceptable level of about 5%. Investment for the growth target is expected to derive from foreign aid, domestic savings, foriegn private capital, private sector investment and increased productivity.

Government expenditure, as a proportion of GDP, is expected to decline as the public investment will concentrate on building the social and economic infrastucture that is vital for an expanding private sector.

The import outlay on food and drink category which accounted for 13.2% of the total imports in 1991, has shown a slight improvement with regard to rice, sugar and flour and is shown in Table A6.1-5.

(1) Peoplization programme

The Government is strictly following the principle of not investing in ventures which are directly production oriented, and which are suitable for private ownership and control. Existing public sector commercial enterprises are being gradually divested to the private sector. This is achieved through the programme of peoplization of public enterprises where a policy of broadbasing ownership is followed. One of the main features of the scheme is that 10% of the shares of the venture is retained for distribution among the workers, and a further 40% is sold to the general public. The majority tranche of shares in the state enterprise is offered for sale to corporate investors through competetive bidding. The rationale is that majority ownership by a corporate investor who has the necessary financial capacity to expand the enterprise, the ability to transfer technology and the ability to expand market access, would be the best guarantee for the future growth and expansion of the peoplized enterprise. Up to end of 1991, eight state